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Signaling with one hand and watching the returning ray through the attached Zeiss prism monocular.

A TRIPLE MIRROR FOR SECRET SIGNALING.—[See page 346.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Physical Safeguards in Railroad Travel

IN three fatal disasters during the past few years, causing the death of twenty-three passengers, the New Haven Railroad has proved the futility of attempting to protect the lives of its passengers against dangerous crossovers by giving instructions to its engineers not to take the crossovers at a speed above fifteen miles an hour. The Bridgeport disaster, the second of its kind, led to a strong remonstrance and several recommendations from the Interstate Commerce Commission. Nothing, however, was done to remedy the defects, and a little over a year later a similar disaster, due to similar causes, occurred at the Westport crossover.

In the investigation of this accident by the Interstate Commerce Commission the vice-president of the road was asked "What action, since the Bridgeport accident and the report that was made on it under the auspices of the Interstate Commerce Commission, has the New Haven road taken to prevent a recurrence?" The answer was: "We have done all we know how." As a commentary upon this reply, we invite attention to the article on the Westport wreck, and particularly to the diagrams and photographs which illustrate it, to be found elsewhere in this issue.

Perfectly natural was the oft-reiterated question of the members of the Commission as to why the New Haven Railroad had not lengthened its crossovers, or introduced some form of the automatic stop. The statement of the vice-president that the lengthening of crossovers would not prevent such disasters is simply preposterous. There is not a maintenance-of-way engineer on the whole 260,000 miles of railroad in this country, who would not wish to put in at express track crossovers the easiest switch that the local conditions at the track and the ingenuity of the switchmaker permit. It is all very well for the New Haven officials to talk of "stiffening discipline;" but they know very well, or it is their duty to know, that the safety of the traveling public demands, in addition to the stiffening discipline, that the tracks, the signal system and the rolling stock shall be made as proof against the errors of human fallibility as the ample financial resources of the New Haven Railroad Company can make them.

We look in vain for evidence that the company has made any effort to improve the physical conditions, even at those points which previous disasters had shown to be full of menace. The public may well ask "Why, with the example of the Pennsylvania and New York Central roads before it, to say nothing of the recommendations of the Interstate Commerce Commission, has the New Haven road been guilty of such neglect?"

The Nobel Prize Awarded to Dr. Carrel

IT is with special gratification that we Americans note the award of the Nobel Prize for Medicine to Dr. Carrel of the Rockefeller Institute for Medical Research. While Dr. Carrel is French by birth and training, his epoch-making researches have been for the most part conducted on American soil.

There is no need, in speaking to our readers, to more than briefly mention the principal products of Dr. Carrel's genius. He won his spurs in public recognition by his wonderful work in blood transfusion, of which an account has already been given to our readers in one of our August issues of last year. In 1909 he entered the Rockefeller Institute for Medical Research and began his investigations on the continuance of tissue life in excised portions of the animal body. These are of the highest interest, both from the point of view of pure science and also in their application to medical and surgical practice.

From the standpoint of theory it may well be said that our ability to cause the growth of living matter *in vitro* brings us perhaps one step nearer to that dream of the biologist—the production of living matter—which was so ably commented upon by Prof. Schäfer in his recent address. From the practical point of view several important reflections present themselves. Dr. Carrel has found that the medium which in normal life surrounds each tissue, is not the one best adapted for its growth. This implies on the one hand the possibility of perhaps stimulating the growth of certain organs or tissues, as the need may arise, by medication with specific substances affecting that particular tissue. It suggests, on the other hand, the possible opposite procedure of checking the growth of abnormal structures, such as tumor and cancers, by similar medication. It will be remembered that efforts in this direction were made some years ago by Prof. Beard of Edinburgh, unfortunately without any apparent success.

But what appears undoubtedly at present the most promising field of application of the results obtained by Dr. Carrel is the grafting of foreign healthy tissue in place of diseased or injured tissue. In order to be able to practise such transplantation as a matter of regular routine, and not as a mere occasional medical curiosity, it will be necessary to have on hand and preserve for use suitable portions of living tissues. The possibility of keeping alive for several months portions of excised animal organs placed in a suitable nutrient medium, as demonstrated by Dr. Carrel, is from this point of view of the highest interest. And the importance of this line of work is proved beyond peradventure by the successes recorded by Dr. Carrel in the actual transplantation of entire organs, such as the kidney, in animals. The new organ thus engrafted has been found capable of fulfilling in every way the functions of the normal and natural organ.

The Nobel Prize is intended as an award for achievements of no ordinary merit. So long as there are men like Dr. Carrel for candidates we need entertain no fear that the prize should ever lose any of the prestige which so justly attaches to it.

Farm Economics

THERE are many reasons why the subject of Farm Economics should command special interest. In the first place it concerns directly and personally a large and important class of our population. Then, again, indirectly we are all dependent upon the farmer for the most indispensable of all our supplies—our food. To the student of political economy the special branch of agrarian economics presents some features of particular interest owing to its fundamental character and its close relation to the most primitive wants of man.

Our Government is doing splendid work in collecting data which must be welcomed by each of these classes of persons interested, but most of all by the farmer to whom the question of the judicious distribution of his investment, to the best effect, among the several items incidental to farm management, is a matter of dollars and cents.

Bulletin No. 212 of the Bureau of Plant Industry, "A Study of Farm Equipment in Ohio," gives a most valuable review of important data of this character gathered and collated with much painstaking care by Mr. L. W. Ellis.

On twenty-one farms investigated the following was found to be the average distribution of capital invested: In land, drainage and water supply, 61 per cent; in buildings, 21 per cent; in implements and machinery, 5 per cent; and in live stock, 13 per cent. The bulletin gives much detailed information, of which the figures just quoted represent a gross summary.

Ours is the day of scientific management. No longer need the farmer slowly find his way to the best working conditions by a series of successive approximations—the Government helps him to profit by the experience of others, who have preceded him, and have paid the heavy dues of that excellent but dear schooling.

The Problem of Launching the Naval Hydro-aeroplane

THE development of the hydro-aeroplane seemed at the very beginning of its dual application to promise speedy acceptance by the navy as a military adjunct for the purpose of scouting. The partisans of this modified aircraft lost no time in making all sorts of extravagant claims for it. According to them, the fleet was to have new eyes at a small cost, and the aviator was to do prodigious things in the way of helping the fleet commander to guard against surprise while himself taking advantage of every opening presented by an unwise maneuver on the part of the enemy.

There are some physical conditions which, unfortunately, make the practical acceptance of the aeroplane on shipboard hard to realize. The notable flights of Ely from the U. S. S. "Birmingham" two years ago and the later performance of the same aviator in flying to the U. S. S. "Pennsylvania" and returning from that ship, showed what could be done under favoring conditions; and they also proved that the aeroplane was quite unfitted for associate operations with a craft at sea—especially if the flying machine was forced to take to the water. The extremely cumbersome launching and landing platforms, well enough for an experiment, could not be tolerated on a fighting ship in time of war. The logical outcome was the hydro-aeroplane. The very frailty of the flying machine marked it an easy prey for rough waters; and while its pontoons might serve to add an element of safety for the benefit of the aviator, still they could promise but little protection for the planes and general structure if exposed to waves of any force and weight. This has been discouragingly exemplified upon many occasions up to date. It was evident that even the water-plane was no better than the aeroplane, if it had to start from the water or return to that element when the surface was much agitated. Accepting, then, the pontoons as features of safety, the next logical effort was in the direction of finding an efficient means for getting the aircraft away from the deck of the ship.

The problem of successful launching has been given much thought, both here and in Europe. On the other side of the Atlantic the *pros* and *cons* of the Wright launching rail have been discussed with more or less thoroughness, and among naval aviators it is generally looked upon as a possible last resort, but not the ideal demanded by the conditions afloat and the requirements of the latest types of high-speed machines. Shortness of runway is arbitrarily fixed in a measure by the essentially military features of the man-of-war, and for that reason some form of impulse had to be devised which would give the aircraft the needed velocity of headway within a short distance. Capt. Washington I. Chambers, U. S. N., has been quietly working for months upon a launching apparatus which, in effect, is a sort of pneumatic catapult. This mechanism received its initial test at Annapolis during the past August, and while the aeroplane took a tumble, still the broad idea of the installation gave gratifying promise. It is quite probable that when the control of the impulse and its acceleration are properly adjusted, the apparatus will prove quite practicable within limits. However, it is not a question of throwing a solid mass into the air, but the far more delicate problem of getting a sensitively balanced kite, as it were, started on its flight against the opposing air. The tests at Annapolis clearly showed how disturbing was the effect of a slanting wind and how necessary it probably would be to get the aeroplane launched squarely against the breeze. Even though the catapult be installed so that it can be made to face the wind, that does not dispose of the difficulties. A big ship in motion very seriously modifies the streamlines, so to speak, of the air currents, and the higher the speed of the vessel the more profound the aerial perturbation. Only big ships will be able to carry associate aircraft, and here we have another aspect of the question to vex the experimenter. Only a short while ago, an Italian aviator was maneuvering in a hydro-aeroplane over the waters of the Gulf of Spezia. By chance, the battleship "Dante Alighieri" was running some of her trials at the same time. The "Dante Alighieri" is credited with a full speed of something over 24 knots an hour. Whether she was running at her highest rate then is not certain; but the aviator, swinging through the air across her wake, suddenly found his machine beyond his control, and down he plunged into the water. The mishap was unquestionably due to the disturbed condition of the air produced by the passing battleship.

Of course, there is a point forward on a ship under way where the air passing sternward probably flows fairly evenly, and the studies of the naval aviator must be twofold: first to evolve a satisfactory launching machine and then to place that apparatus where it may do its work with the least risk to the aircraft. The public should not be hasty in its judgment or rash in its conclusions. All of these difficulties will be skilfully overcome in time, but the hour for the aeroplane on shipboard has not yet arrived. It must be remembered that there are the corresponding difficulties of returning to the ship after a flight. Will the flying machine be able to make a successful landing aboard if a wind is blowing and the air currents are much disturbed? This is decidedly debatable.

Electricity

Street Lighting as Police Aid.—An Indiana city has recently utilized a special street lighting system that had been installed for ornamental illumination to assist the police in case of an alarm after the lights have been turned off at night. A controlling switch in the office of the chief of police enables the lights to be flashed on while officers are scouring the streets.

The Smallest Dynamo in the World.—An electric generator only 15 millimeters in height, weighing only 7 grammes and wound with silk-insulated wire was recently exhibited before the French Academy of Sciences. The armature of this diminutive machine is 6.2 millimeters in diameter, and the commutator and brushes are constructed as accurately as in a large machine. The output is about 2 amperes at 2.5 volts.

Photo-telegraphy Without Selenium.—Paris daily newspapers are beginning to use pictures transmitted by a method employing a copper plate prepared from the original photograph negative. This transmitting plate resembles a half-tone plate and consists of parallel lines in gelatin upon the copper surface. In the black parts of the picture the lines are wide, covering nearly all the space, and in the whites they are very narrow. The plate is wound around the cylinder of a transmitting instrument, synchronized with a receiving instrument which operates by the deflection of a beam of light.

Electrical Operation of a Bascule Bridge.—An electric motor-operated bascule bridge of a railroad company over the Calumet River, near South Chicago, Ill., is supplied with power from an isolated plant with an equipment of storage batteries. The object of the auxiliary storage battery plant is to enable an electric generating plant of small capacity to be utilized without overloading of the generators or risk of failure in the operation of the bridge. The electrical control of the bridge is interlocked with the signal system of the railroad trackage passing over the bridge, so that it is impossible to receive any current on the controller until the proper signals have been set.

The Part of the Electric Motor in Irrigation Work.—The irrigation of what used to be known as the Great American Desert has shown this strip of country to be very fertile land that had needed only adequate water supply, and the extension of irrigation has been part of the development of several of the great electrical transmission systems in the arid zone. At the same time the more refined experience with irrigation has shown an important application of the electric motor, viz., for the pumping work necessary to make the newly provided water supply available to the farmer. The actual amount of water needed (under skillful farming) is small and may be brought to the farmer's very door by motors supplied with electrical energy at a favorable rate, viz., $20 per horse-power for the six months' season.

Co-operation in Power Supply.—Nowadays the co-operation of public service companies not only helps out with the supply of many things which formerly all individuals and concerns had to provide for themselves, but gives a commodity of better quality than the small consumer could possibly afford otherwise. The electricity supply companies, especially, step in to give many private consumers far better light and power in both home and workshop than they could provide for themselves. This important feature of modern civilization is brought to mind in a recent number of a German electrical paper, pointing out the superiority of the electric motor over the gas or gasoline engine under certain conditions. Where the load is intermittent and relatively small and the ruling considerations are convenience, simplicity, and cleanliness, using the electric motor, that is, energy delivered by wire from a central generating station, is a cheap solution of the power problem. When power is required for long periods and in large amounts, however, there is a point beyond which the internal combustion engine will be cheaper than the motor.

The Vogue of the Steam Turbine in the Generation of Electricity.—The large extensions to electrical supply equipment in Chicago that are now in hand call attention to the vogue of steam turbine generators in the huge projects at the present time superseding the engine-driven generators that were universally employed in the earlier days of electrical engineering. For the Fisk Street Station, Chicago, a 25,000 kilowatt, 4,500 volt, 3-phase Parsons' horizontal unit, having a speed of 750 revolutions per minute, is now under construction. This generator will be about 75 feet long and 18 feet wide. The addition to the plant will be large enough to house four of these units, bringing the ultimate capacity of this station up to 220,000 kilowatts. The project for the new Northwest Station in the same city comprises twelve 20,000 kilowatt vertical steam turbine generators to be housed in two similar groups of buildings, and two of these units are now installed. The rotating member, containing six disks with a total of 7,392 buckets and weighing almost exactly 100 tons, is supported on a step bearing which is supplied with oil at a pressure of 800 pounds per square inch.

Aeronautics

Monoplanes Abandoned by the British Army.—Following the example of the French, the British government has decided to use only biplanes for military purposes. The many deaths that have occurred in the last few months is the obvious reason.

Test of a New Wireless Apparatus for Aeroplanes.—A wireless apparatus recently designed for torpedo boats and submarines is being tested out in a Curtiss military biplane at Hammondsport, N. Y. The generator is said to weigh less than five pounds and to be driven by a source of power other than the aeroplane motor, so that it is not affected by accident to the latter. On October 14th this machine was flying above Lake Keuka at night with a powerful searchlight, which would go out every time the aviator sent a message and would light up again as soon as he stopped sending.

Two Airship Patents.—Frederick Brackett of Washington, D. C., has secured patents, Nos. 1,039,092 and 1,039,251, for airships, the former including a steering mechanism which has a frame alongside the craft and inclining downwardly toward one end of same with a number of planes spaced apart in the frame. The patent, No. 1,039,251, has a number of containers each formed of an elongated and pointed element substantially rectangular in cross section and curved longitudinally with the containers arranged side by side in superposed groups in such manner as to provide planes, suitable propelling means being provided.

Russian Military Aviation.—The Russian military aviation concourse was opened on September 4th at the St. Petersburg aerodrome, and is the first one of any account to be held in the country. Eleven aeroplanes were entered, most of which, like the "Sikorsky," "Dux," "Haeckel" and others, were of home make. There were also two German flyers entered. The conditions were as follows: A continuous flight of 1½ hours with a load of 400 pounds, and gasoline and oil for a 3-hour run. Six speed flights, forward and back in straight line, a 15-minute flight at 1,500 feet height, and a 10-minute flight with an extra heavy load. Also mounting and dismounting the apparatus, hard flights from plowed or grass-covered fields, and the like. The three prizes were $16,000, $8,000 and $5,000.

Safety of the Hydro-aeroplane Again Demonstrated.—On October 11th, Marshall E. Reid, the young Philadelphia aviator, and Lieut. Com. H. C. Mustin, of the Philadelphia Navy Yard, attempted to fly from Cape May over Delaware Bay to Philadelphia. The flight was made in Mr. Reid's Wright biplane which he has equipped with floats, lately. Some time after the start of the flight, while the men were 500 or 600 feet above the waters of Delaware Bay, a cylinder head blew off and the aeroplane dived to the surface of the bay. In some unaccountable manner the gasoline caught fire, and the machine was ablaze when it struck the water. The occupants managed to put out the flames, but as the weather was foggy, there was nothing that could be done except to wait until they were located. They were eighteen hours upon the leaky pontoons before an oyster patrol boat picked up the men and their machine and landed them at Port Norris, N. J. After this adventure young Reid is highly in favor of the hydro-aeroplane as he believes if the accident had happened above the ground both he and his companion would have been killed. It would be well to have some sort of a shrill signaling device on an aeroplane, that could be used in case of an accident like this in foggy weather.

Opening of the Aeronautical Society's New Field.—The new aviation field recently secured by the Aeronautical Society at Oakwood Heights, Staten Island, was auspiciously opened on Columbus Day by a model aeroplane contest and a number of exhibition flights by leading aviators. Three records were broken in the former events, and the finish of the program was a daring parachute jump from Harry Brown's Wright biplane by Frederick Rodman Law, this being the sixth time that this daring parachute dropper has performed this feat in mid-air. He carries the parachute folded upon his shoulders and attached to a sort of harness of heavy leather straps passing around his body and limbs. He made the leap from a height of 5,500 feet and was nearly ten minutes in descending to earth. Mr. Brown, despite his injured wrist, handled his machine splendidly and there was no perceptible waver when Law jumped overboard. Mr. Law's sister, Miss Ruth Bancroft Law, also made a pretty exhibition flight in her Wright biplane, and Mr. E. Weeks of Scranton, Pa., made an exhibition flight in a novel combined Curtiss and Farman biplane. Shooting at bunches of three or four toy balloons by Mr. Dillon Hoffman while circling about in Brown's machine was another feature of the exhibition. Mr. Brown was unable to operate his Wright in a gusty wind so that Hoffman could hit the balloons, although the latter holds the record of hitting eighteen out of twenty balloons. Over 6,000 people attended the meet. The interest and enthusiasm manifested prove that aviation is not dead in America.

Science

New Director of Dudley Observatory.—Benjamin Boss has been appointed to succeed his father, the late Dr. Lewis Boss, as director of the Dudley Observatory. Mr. Boss was born in 1859. On graduating from Harvard University he joined his father in the work at the Dudley Observatory. In 1906 he became Director of the United States Naval Academy Branch at Patuila, Formosa, which position he held for three years.

Progress of Cremation in Europe.—There has been a marked increase in Europe in the use of cremation as a method of disposing of the dead. Last year there were 7,555 cremations in Germany as against 6,500 in 1910. At present there are thirty crematories in Germany and almost as many in Italy. In England there were 1,033 cremations in 1911 as against 840 in 1910. Recently Switzerland has passed a law which practically makes interment exceptional.

Ageing Yellow Leather.—Max de Nansouty says in *Les Annales* (Paris), "A specialist gives us the details of the following process for imparting to new yellow leather a look of age. It is first washed with plenty of water and thoroughly dried; then the surface is coated with a layer of vaseline. When this layer has been absorbed by the leather another is applied, this being kept up till the leather is saturated. Only four applications at most are required to give the leather a very deep color. When dry it will be dull, but a polish may be imparted to it by any sort of encaustic.

Artificial Cow's Milk.—A recent press dispatch states that three German chemists at Frankfort-on-the-Main have discovered a method of making milk synthetically in the chemical laboratory. According to the dispatch several scientists, including Sir William Crookes, tasted and tested this milk and pronounced it palatable. It is proposed to manufacture the milk in London and sell it at six cents a quart. The milk is made entirely from vegetable ingredients digested in a "mechanical stomach." Be that as it may, we hope that there is some truth in the report, for there could be no danger of tuberculosis or any other disease germs in the synthetic product.

Purification of Coal Gas.—One of the most valuable and original of the communications before the Eighth International Congress of Applied Chemistry was one by Dr. J. C. O'Neill. It relates to the continuous purification of coal gas with weak ammonia. The gas that leaves the condensers is washed with a weak liquor of ammonia, instead of with the gas liquor itself, found in the first scrubber. Thereby the whole of the cyanogen is absorbed and also the greater part of the hydrogen sulphide. The temperature of the gas and the wash liquor should be above 30 deg. Cent. The wash liquor from the scrubber is returned to the ammonia still, and the impurities saturate the concentrated ammonia in the condenser of the still. Six months' trial of the process showed that the oxide in the purifiers was insufficient to deal with the gas when the latter was washed with liquor in the ordinary way.

Death of a Prominent New York Chemist.—On the eighth of this month the death was reported of Prof. Morris Loeb, who has for many years past figured prominently among the chemists of New York city. Dr. Loeb was formerly professor of chemistry at New York University, but had of recent years retired to conduct researches in his own private laboratory. His work dealt chiefly with certain phases of inorganic and physical chemistry. But his activities were not confined to the direct advancement of science alone. He will be specially remembered for his public services, and, among chemists, for the active part taken by him in founding the Chemists' Club and in raising a building fund for the headquarters of that club, completed in 1911. He held the office of president in this organization in 1909 and 1912. At a special meeting of the Board of Trustees of the Chemists' Club of New York city, held October 8th, the following resolutions offered by a committee consisting of Mr. Ellwood Hendrick, Mr. Clifford Richardson and Mr. Walter E. Rowley were adopted:

Whereas, Morris Loeb, the president of the club, has been taken from us by death, and

Whereas, He was the leading spirit in bringing to fulfillment ambitions and plans that had long been ours, and

Whereas, He was always ready to shoulder burdens and to give help, and

Whereas, He was a man of order, and of integrity in mind and in heart, sincere in scholarship, living without malice or scorn, speaking no evil, and generous in judgment, and

Whereas, We were drawn to him by ties of deep and abiding affection, now, therefore, be it

Resolved, That we make this minute of our poignant grief at his passing, and that we cherish his memory as another of his great gifts to science and to humanity.

The "Immortality" of Tissues

Its Bearing on the Study of Old Age

By Genevieve Grandcourt

A VERY evident disadvantage under which medical science has labored has been the impossibility of watching the chemical process set in motion by substances introduced into the body. For this reason various experimenters, from time to time, have attempted to "grow tissues" artificially, in such manner that their development, functions and decay—under both healthy and diseased conditions—might be studied under the microscope. The only way in which this could be done would be to take a piece of living tissue from the body, and cause its cells to multiply; tissue being made up of an aggregation of cells.

Science has failed to produce a single living cell, that is, a cell which will undergo the process of nuclear division (growth) which is the prime condition of its being; and it seemed equally impossible to cause a cell already living to undergo the same process if deprived of the circulation of the blood. Therefore, when in 1910 it was announced that Dr. Alexis Carrel with his assistant, Dr. M. T. Burrows, had succeeded, scientific credulity was taxed. A well known French savant expressed the opinion before the Society of Biology in Paris, that as others experimenting along these lines, had witnessed only degeneration and survival of cells, this phenomenon was all Carrel's discovery amounted to. In view of past experience, indeed, the chances were in favor of a mistake. In 1907, Leo Loeb said that he had produced this artificial growth both within and without the body. Obviously, such development within the organism where the process of utilizing the body-fluids, etc., follows the same course as in nature, takes on the character of grafting rather than of cultivating in a culture medium. As to causing the external growth, it was ten years later before it seems first to have succeeded. In 1907 Harrison, from Johns Hopkins University, furnished details of his research in such form as to be convincing. But his work had reference to the growth of tissues only of cold-blooded animals, he having cultivated artificially, nerve fibers from the central nervous system of the frog.*

Carrel's work consisted in extending Harrison's method to apply to warm-blooded animals, including, of course, mammals; he having primarily in view at this time a more precise knowledge of the laws governing the restoration of tissues, for example, after serious surgical wounds. He and his assistant worked steadily to this end, and succeeded. The tissues of the higher animals, including man, can now be developed in a culture, and such development can be made to correspond to a rigidly precise technique. The feat is accomplished by putting minute pieces of living tissue into a plasmatic (blood) medium which will coagulate. So complicated is this apparently simple matter in its application that only the most exquisite surgical skill is proof against incalculable modifications in results.

The plasmatic medium in which the growth takes place consists of blood which by a centrifugal process has been deprived of its cells. Generally speaking, it must be taken from the animal whose tissue is to be cultivated or from an animal of the same species, although chicken-tissue has been grown variously in the blood of human being, dog, and rabbit. The tissue is excised from the etherized subject under circumstances which are an absolute guarantee against bacterial infection, tearing, chilling, drying, etc., and so liable is tissue to be killed by exposure to the air that it is safer to dissect it in serum. Both plasma and tissue may be kept in cold storage, although the time within which each can be preserved varies largely with the different species of animals. The plasma of the rat is useless in much less than a day, while that of the chicken can be kept over a week without coagulating. The dependence of great results upon minute causes is shown by the fact that the tissue from which the growth is to take place must be exceedingly small; the reason being because only the outer edge of the tissue can get nourishment when deprived of the normal blood circulation. When the tissue is of any extent, all but the periphery dies.

Dr. Alexis Carrel, who recently won the Nobel Prize.

In order to view the changes in form (morphology) of the cells, small quantities of tissue are grown by putting a tiny piece cut from the excised fragment on the inside of the cover of a glass-slide, and overlaying it very thinly with the prepared plasma. When the cover is adjusted to the slide and sealed with paraffine (to keep the culture moist) it is quickly put into an electric incubator and taken into the observation-room to be deposited in the large incubator provided with a powerful microscope. The plasma coagulating either when it receives the tissue or at once upon feeling the heat of the incubator, the tissues grow in what is described as "the hanging drop culture" downward into the glass-slide. The growth can be observed after a latent period varying according to the nature of the tissue, the time elapsing since it has been deprived of circulation, etc. The microscope shows the direct division of the nuclei, and the growth taking the form either of layers or of so-called "radiating chains," depending upon whether connective or epithelial tissue is being developed. In other words, the cells either spread far out into the medium or pack up, so to speak, in a dense mass.

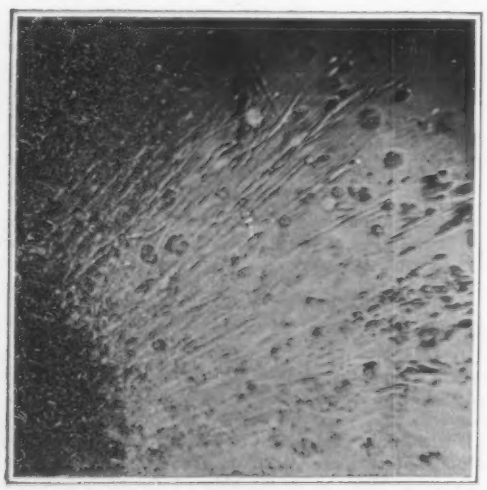
So far so good. But it is necessary to study not only the morphology, but the dynamics (movements) of the cell-multiplication. For this latter purpose, a large quantity of tissue was grown on plates. More recently, both kinds of culture have been modified "with the view of obtaining better support for the cells and better nutrition for the cultures," but the process is too involved to be described in a paper of this length. Having obtained evidence that tissue can be cultivated in accordance with a formula that may be relied upon to give definite results, the effort was made to grow artificially the various malignant (cancerous) tissues, in turn of chicken, rat, dog and human being. Cancerous tissue invariably developed cancer, and so rapidly and extensively that the growth could be observed with the naked eye.

It now became evident that, under the right circumstances, the artificial growth of tissues could be utilized in the study of many problems; such as malignant growth of tissue; certain problems in immunity, as, for example, the production of anti-bodies and anti-toxins of certain organisms; the redintegration of tissues; the regulation of the growth of the organism, or of different parts of the organism; rejuvenation and senility; and the character of the internal secretions of the glands, such as the thyroid which plays a rôle most important in physical and mental development. The difficulty lay in the fact that the artificial growth was so very short-lived. It was found that by passing the growth into a new medium, and repeating the process, the tissues would begin to grow again; but their life even under these circumstances was limited at the most to twenty days. This was manifestly too short a time in which to study the fundamental questions to which the researchers had addressed themselves. Thereupon, study was taken up to determine the question as to *what made these tissues die.* It was found that, apparently as incidental to growth, there was the process of decay, due to an *inability of the tissues to eliminate waste products.*

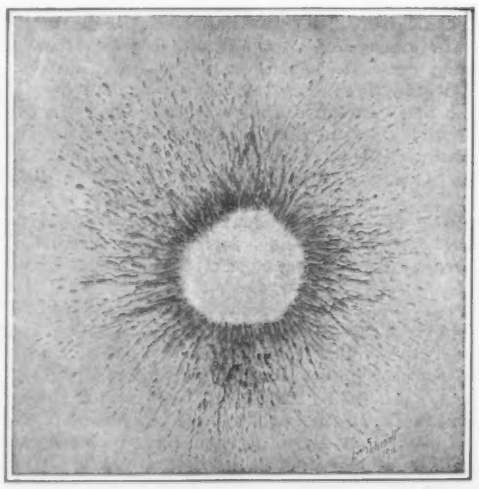
On January 17th, 1912, experiments were commenced to determine whether these effects could be overcome. The observations were on the heart and blood-vessels, artificially grown, of the chicken fetus; the tissue being taken from an embryo of seven and an embryo of eighteen days. These growths were put into a salt solution (Ringer's) for a few minutes at different periods of their growth, and then placed in a new plasmatic medium. It was found that by following this method, the tissues could be made to live indefinitely; and the conclusions were drawn by the following very curious facts. When an animal is in the early stages of its development, the growth of its tissues is necessarily greater than as it matures, there being steady

(Continued on page 355.)

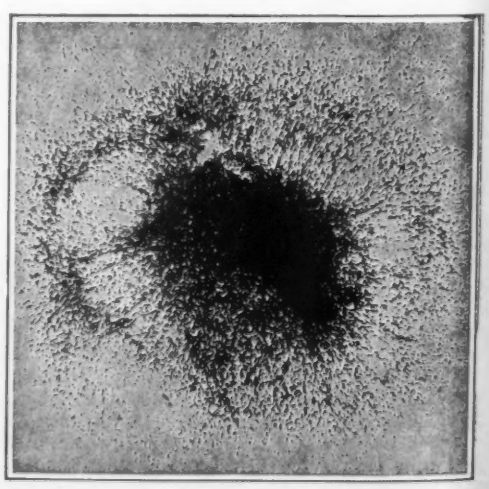
* *Journal of Experimental Medicine,* Volume XIII, No. 3, 1911, p. 388.



Twenty-four hour old cancer growth (sarcoma) from piece of tissue extirpated from rat. The growth was from tissue the size of a millet seed.



Connective tissue in permanent life. Demonstration that this particular tissue does not age in artificial growth.



Five-day cancer growth (sarcoma) from piece of tissue extirpated from chicken. The growth was from tissue the size of a millet seed.

Lesson of the Railroad Wreck at Westport

The Imminent Peril of the Short Crossover

ON July 22d of last year the SCIENTIFIC AMERICAN, in commenting on the disastrous crossover wreck near Bridgeport on the New Haven lines, said: "It would be entirely possible to lay out the tracks with switches and curves so easy, that, if a heavy express train disobeyed its orders and swept over a crossover at a speed of sixty miles an hour, it could do so without any grave risk of derailment."

Fourteen months passed away without the New Haven Railroad taking any steps to lengthen its crossovers, with the result that about the sunset hour of a September day, and at a point on the company's lines only a few miles distant from the scene of the Bridgeport wreck, that disaster was almost exactly duplicated. An express train, drawn by one of the heaviest engines on the division, dashed by the signals and swept at a speed of from fifty to sixty miles an hour over one of these death-trap crossovers, whose length, in this case, did not exceed 200 feet.

Had the New Haven Railroad Company done its duty, torn up these crossovers and rebuilt them according to the best modern engineering practice, as carried out on the New York Central and the Pennsylvania Lines, that express train, even had it been running at sixty miles an hour, would have passed through without derailment, and the ghastly horrors which followed would have been prevented.

In the investigation of the accident by the Interstate Commerce Commission, at which the writer was present, the leading officials of the railroad took the most astounding position, that, since they had made a standing order that this particular crossover was not to be taken at a speed of over fifteen miles an hour, the sole responsibility for the wreck was to be placed upon the engineer of the train. Furthermore, they did not hesitate to assert to the Commission that they had done everything practicable in a physical way to prevent such an accident. The attitude of the New Haven road is shown by the following extract from the evidence, as printed in the daily press:

"By Mr. Higgins (of the Commission): Would not the lengthening of crossovers at least materially decrease the element of danger? Answer (by Vice-President Horn): We feel that it would only be a question of time until men took the longer crossovers as much too fast as they take the shorter ones.

"Question: But would not the element of danger be decreased? Answer: I would state that in the end the longer crossover would make the situation worse. It would be putting a premium on violation of the rules." Again, the same witness is reported to have said: "We couldn't find that lengthening that crossover" (at Bridgeport) "would have helped the situation any." If the vice-president is correctly reported, these statements must be characterized as some of the most astounding that ever came from the mouth of a responsible railroad official; for they can mean nothing else than that this company refuses to do what it can in a physical way to render crossovers safe. In other words, the policy is to trust everything to the always fallible human element, and refuse to make those physical changes in the tracks, which would reduce the danger, due to disobedience or neglect, to a minimum.

We are fully satisfied that there is not a single railroad engineer—certainly not an engineer of maintenance of way—in the whole United States who would subscribe to the last statement of Vice-President Horn. As a matter of fact, crossovers on express tracks can be made absolutely safe for the fastest speed at which an engineer can pull his train through them. Has this witness never heard of the Pennsylvania Railroad? Does he not know that on the main lines of that road crossovers have been built within the past few years with a special view to eliminating risks due to disobedience of orders by engineers? Does he not know that on that road there are crossovers which are so easy in curvature and of such great length, that the railroad has imposed no speed limit whatever upon the engineers in running over them?

If the New Haven high officials, those who have to do with the appropriation of the necessary funds to carry out improvements suggested by its staff of engineers, are in ignorance of these facts or blind to their significance, the SCIENTIFIC AMERICAN invites their attention to the accompanying photographs and diagrams, showing the existing dangerous conditions at Westport in contrast with the up-to-date methods of construction adopted on more than one of the first-class roads of this country.

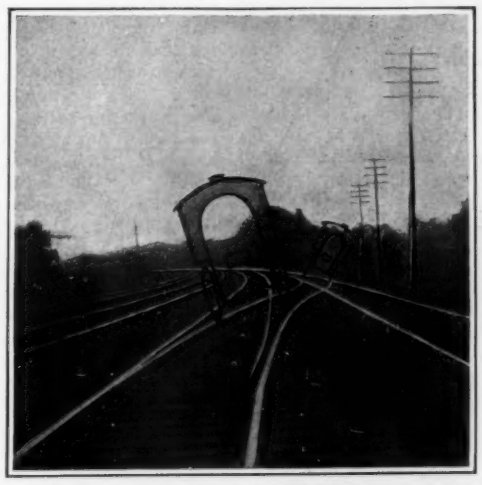
It will be evident to any railroad engineer who studies the accompanying plan of the track layout at Westport, that the motives which led to the creation of and persistence in the present conditions there, are those of convenience and economy. The freight yard for the handling of goods destined for or shipped from Westport and Saugatuck, lies on the north side of the tracks, and is entered from a siding whose switch is distant about 750 feet to the westward of the station. For the accommodation of freight cars destined for Westport, three crossovers connect the two eastbound and the express westbound tracks with the siding and the yard. For a distance of about seven hundred feet to the west of the station the tracks are on a tangent. Then commences a curve to the left. Because of the super-elevation of the outer rails on these curves, it was impossible to place any of these crossovers on the curve, and consequently they were restricted to a distance of about seven hundred feet. To get them within the limited space available, it was necessary to use a short crossover—in this case what is known as a number ten. In addition to serving the freight yard, these crossovers are used to transfer express trains from the local to the express tracks or *vice versa*, when the expresses have to make station stops, or have made them and wish to return to the express lines.

Now, in view of the fact that express trains on this line frequently run at speeds of seventy miles an hour or over, and in view of the fact that the human element as represented by the engineer is fallible and that the engineer, however good a man he may be, is liable to forgetfulness, momentary carelessness, or physical disability—due regard for the safety of the traveling public, should have led the company to place some of these crossovers to the east of the station and others to the west of it, making them of such a length and with such easy switches and frogs, that in case the speed order was disobeyed the train would pass through without risk of derailment.

As a matter of fact, considerations of convenience, economy, or what not, led the company to crowd all three crossovers into the restricted space between the station and the point of curve (commencement of curve) seven hundred feet distant. Short crossovers were put in and a standing order was made that they were to be taken at a speed not to exceed fifteen miles per hour.

In this case, as in the accident at Bridgeport, fourteen months before, the engineer swept through the crossover at a speed, as estimated by witnesses, of from fifty to sixty miles an hour. Strange to say, the huge engine passed through intact; but in doing so the great centrifugal forces developed set up a rolling action which threw the engine entirely from the track. When it struck the first switch, the reaction of the sharply-curved rail caused the engine to lurch heavily to the left. Then, on the rebound, with a pendulum-

(Concluded on page 358.)

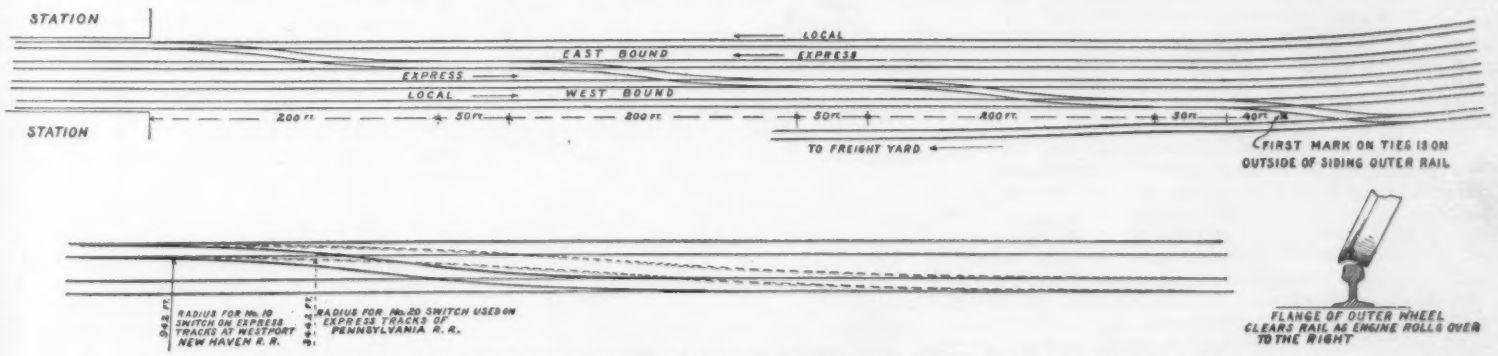


The sharp curve to the right caused the engine to lurch heavily to the left. The action of the springs then threw the engine over to the right. In this position it entered the second curve, which completed the overturning.

Westport switch, looking west.

Not only was this crossover too abrupt to be placed on express tracks, but it was carelessly maintained. Note the sharp jog in the curve at the point indicated by the arrow.

Westport switch, looking east.



The upper drawing shows how three crossovers were crowded into the 700 feet between the station and the curve to the left.

The lower sketch shows the sharp curvature of the New Haven No. 10 crossover compared with the easy curvature of the Pennsylvania No. 20 crossover. The overturning effect of the No. 10 is nearly four times greater.

The right and the wrong way to lay out express track crossovers.

A Triple Mirror for Secret Signaling

Reflected Beam that is Invisible Out of the Path of the Beam

By C. H. Claudy

ONE of the most recent applications of pure mathematics and the science of optics to warfare is found in the triple mirror, in which the optical principle that "the angle of incidence is equal to the angle of reflection" has been utilized to make a device for secret signaling which is at once effective and portable. The success of the apparatus depends entirely on the discovery and manufacture of apparatus of sufficient accuracy to plane and polish glass into an exact right angle!

The triple mirror, as the frontispiece shows, is, in appearance, merely a round brass case, which can be held in the hand, hung to a mast head, carried over the shoulder or swung from a saddle. Here it is mounted on a tripod. But the most casual glance at it will reveal its peculiarity, which is that no matter in what position it is held, the observer can see in it his own face. He may look directly into it, or look at it from either side, or from above or below—yet always he sees his own face exactly as when directly facing an ordinary mirror.

The principle is that partially shown in the diagram. The mirror itself is a single prism of glass (Fig. 1) the three sides of which are each at right angles to the other at the apex and the base of which is at a forty-five degree angle with the three faces of the pyramid. It may better be described as a corner cut off from a glass cube. It is difficult to show three sides in a two dimensional diagram without confusing the light rays, so but two faces are shown in Fig. 2. It illustrates, however, the fact that the emergent ray of light is sent back by the mirror parallel to the incident ray of light; and this holds true in the mirror itself, with the addition that the third reflecting surface permits this condition to obtain, no matter what the angle between light and surface of the mirror may be.

The mirror may be carried or hung anywhere. A beam of light focused on it from a distance may be visible to anyone at night, yet the return beam, which is parallel to the incident beam and continues with it, is not visible on the darkest night to anyone save the observer who stands directly in its path. If now the mirror be capped and uncapped by the one signaling, those signals are perfectly visible to anyone in the path of the returning ray, but utterly invisible to anyone else.

A horseman scouting across country could be in the focus of such a beam of light and signal back again to those manipulating the light by capping and uncapping his mirror, and his signals be entirely invisible to any watching eye. And no matter how his horse galloped, or what the angle of the mirror, the law of the angle of incidence and the angle of reflection would bring the reflected beam of light back again directly to its source. It is this feature of the apparatus which particularly recommends it for use on shipboard, where communication with sister ships or with the shore may be desired, in such a manner that no one may read the signals or even know of their existence. Wireless signals may be caught and perhaps a code deciphered by any properly tuned apparatus, wig-wags and Ardois light signals can be read by anyone who can see them, but the return beam of light from a triple mirror is so small in area and so faint to the eye, except it be in a direct line with it, as to be absolutely secret at all times.

So accurately are these mirrors made of optically perfect glass, and so refined are the final polishings, that the variation in parallel between the sending and receiving beam of light is less than one foot in two miles. Moreover, the returning beam of light is no larger than the surface diameter of the opening in the mirror—perhaps six inches—so that an observer standing three feet from a signalman cannot read signals returned from the triple mirror at two miles distance.

In practice, the apparatus consists of a small portable searchlight with a magnesia button, which is heated to a white heat with a compressed oxy-acetylene or oxy-hydrogen jet. This light is concentrated and reflected by a parabolic mirror. With this apparatus, a radius of nine miles can be had with proper elevation; with an electric *searchlight* the triple mirror returns a "readable" beam eighteen miles in length. At one side of the sending apparatus is a small telescope which is accurately in line with the focus of the parabolic reflector. Somewhere in the distance is a triple mirror; for the sake of illustration, let it be hung at the masthead of a battleship with the projection light apparatus in a fort on shore (Fig. 3). The beam of light is directed at the battleship. By the time it reaches three miles, it is so spread out and diffused—for it is not of great quantity—as to be

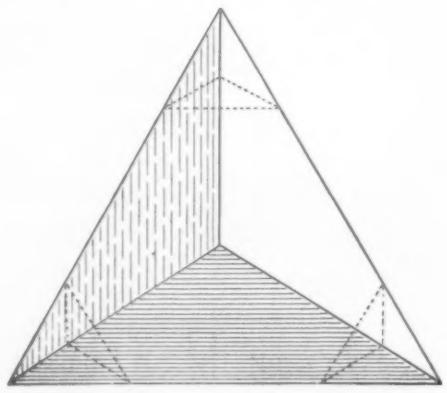


Fig. 1.—Shape of the triple mirror from the back. In use the pointed corners are cut off as indicated by the dotted lines.

completely lost to the eye not looking directly at the source. But some of the rays reach and impinge on the triple mirror at the masthead. No matter how the ship may pitch and toss with the waves, the light ray comes absolutely straight back again to the station on shore; a man with his eye to the telescope sees through it a brilliant white speck only. As a sailor on the masthead caps and uncaps the triple mirror, the brilliant white speck appears and disappears to the eye of the observer at the telescope—three feet to either side—and that bright speck is entirely invisible to any telescope or eye.

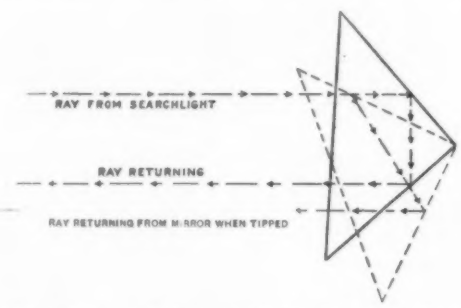


Fig. 2.—Courses of the searchlight rays with mirror tipped and untipped.

Now, it is conceivable that an enemy's battleship might cross between the two at the precise instant such signals were being sent, and that an observer on said battleship might be able to get to the exact point where he could perceive and read these signals, but it is highly improbable. As the circumference of a circle, the radius of which is three miles, is over eighteen miles, and as, at that distance, the diameter of the returning light ray is less than one half of one second of arc, there is not a very large space in which to locate and stand one's self to see an unknown signal.

Fig. 3.—Returning beam, invisible to anyone not immediately in the path of the ray. Tossing of a ship has no effect on the destination of the ray. It always goes to the observer stationed at X.

If it is desired to have intercommunication equally as secret, the battleship would use *its* searchlight and the shore station *its* triple mirror. To the close observer, a ship and a station on shore would each be seen sending forth a motionless ray of light, with no signals passing. But in between and mixed up in these beams would be the smaller, weaker, but truly directed beam from the triple mirror, invisible to any save the eye which knew just where to look for them, and which, interrupted and allowed to proceed, would be sending in perfect silence and secrecy a message of dots and dashes which would not even have to be coded to be unreadable to the enemy.

The apparatus is easily used in broad daylight, in which case, of course, the sending beam is quite invisible, yet so bright is the reflection from the triple mirror, as seen through the telescope, that there is no difficulty in reading its message up to three miles distance. This apparatus is more portable than most land signaling devices, and being entirely independent of the sun, bids fair to take its place among the portable signaling apparatus of all armies, as well as in Germany, where the conception originated. A variation of a thousandth of an inch in the proper angle of the sides of the prism would send the return beam far afield of course; nothing short of accuracy so absolute as to allow but a foot or so variation in several miles would serve, and that degree of accuracy was finally, with difficulty, secured.

An interesting application of the apparatus is its attachment to balloons and aeroplanes, particularly the former. Carrying a searchlight of any power on a balloon is a hazardous undertaking because of the possibility of the heat igniting the gases from the envelope. But the triple mirror can be used to receive and return a light ray from the ground with no liability of danger whatever, and night observations reported to the home station even in the enemy's country without such signaling being seen at all from any one beneath the balloon. With even the most powerful searchlight, it is difficult to locate a balloon a mile high, and the small power light needed to send forth a returnable beam is of no use whatever to an enemy in locating a high balloon.

In fact, in any case where a signal station is desired where even a portable light generator may not be carried, the triple mirror gives excellent results. It is, in reality, a portable, heatless and almost weightless source of light, depending for its power on another source of light at a great distance.

Bacteria for Destroying Locusts

A BACTERIAL epidemic has within two years freed Yucatan of the locust swarms which periodically invaded the country. The malady lasts 12 to 46 hours and is characterized by a violent diarrhœa, the contents of the bowels of the insects yielding a nearly pure microbe culture. The microbe has been isolated by M. F. d'Hérelle, who in a memoir presented to the French Academy of Sciences, examines its specifical pathological effects.

Now, M. d'Hérelle having been asked by the Argentine government to test the effects of the same microbe on another locust species which every year devastates large portions of the Parana district, has reached surprisingly favorable results. As the virulence of the microbe had been weakened by a long series of laboratory cultures, it was at first reinforced by successive vaccinations on locusts. In the first series death was found to ensue after 36 to 60 hours, and in the tenth and following series after 6 to 8 hours. After isolating the microbe in gelose from the bowel contents of the twelfth series, M. d'Hérelle transmitted these cultures to broth which was used for infection. After 24 hours most of the 300-odd locusts kept in a cage and fed with infected lucern had died. After 5 days all the insects were dead, their bowel contents yielding a practically pure culture of the microbe.

Tests made on a large scale were quite as successful. One quart of culture liquid containing the microbe having been poured out on a field, a number of dead locusts were found after 5 days throughout the area of about 90 acres, and the insects continued to die on the following days, the epidemic even extending to the surroundings. The speed with which the malady was spread can be inferred from the fact that a few days after the first infection it occurred at a distance of 50 kilometers (31 miles) from the center of infection, having doubtless been transmitted by the winged locusts, which in Argentina are able in a single night to traverse a distance of 32 kilometers (20 miles).

As other locust species are likewise susceptible to the epidemic, it may be hoped that this will also in other countries afford an effective weapon in the struggle with the dreaded scourge.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Quimby Accident and Gyroscopic Force

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of August 10th and elsewhere, Earle L. Ovington has tried to lay the cause of the Quimby accident to a tangled control wire, instead of to the gyroscopic force of the Gnome motor. In presenting his evidence, however, he has conclusively proven to those who have studied the action of a gyroscope, the exact reverse of his claim, namely, that the tangled control could *not* have been the cause and that the machine acted exactly as this murderous and little understood force would make it act.

Let me quote:

"If you will examine my sketch you will see that by the wire catching as indicated, the rudder would be thrown to the left as it plunged downward. Does it not seem something more than mere coincidence that both Capt. Chase and myself agreed before we knew anything about this caught wire, that the aeroplane *turned to the left* as it fell?"

Take a gyroscope top. Set it rotating and hold it in front of you with the axis parallel to your line of vision so that it revolves clockwise as you look at it, the same as a Gnome motor when seen from the pilot's seat of a Blériot. Turn it sharply to the *left* trying to keep the axis horizontal. Note that the forward end of the axis dives *downward* in spite of you. Tilt it quickly up and note it swerves to the left. Repeat these experiments many times and note that the quicker your turn the more powerful the swerve.

Mr. Ovington admits the presence of gyroscopic force in a revolving motor but asserts it is "negligible" because the plane of rotation is not changed rapidly enough. Let us see:

The Seguin brothers, builders of the Gnome, in an experiment reported in *Aero* (American) of June 15th, 1912, have shown there is 57.6 pounds of gyroscopic force in a 50 horse-power Gnome in a 12-second turn when mounted on a pivoted platform and revolving at 1,200 revolutions per minute. Mr. Thomas Preston Brooke, who first drew attention to the dangers of this force has proved that in a case of this kind the supporting platform receives approximately 80 per cent of the gyro strain. Therefore the Seguin figures represent about 20 per cent of the amount of force that would be present in the same engine if it were floating in air unsupported. However we will consider their figures as given. According to Albert Kapetyn (see English *Flight*, November 19th, 1910), and M. Bouchard Praceig of Society of Engineers of Paris (see *La Nature* of March 4th, 1911) the amount of this force increases as the square of the speed of the turn.

If there is 57.6 pounds of gyroscopic force in a 12-second turn there is 12 times as much or 691 pounds of it in a 1-second turn and 1,382 pounds in a half-second turn. Remember that a complete turn is not necessary but that a change in the path of flight of 1 degree at the speed of a complete turn in 1 second arouses the same force as a 360-degree turn, the speed being constant.

I quote again:

"As the tail of the machine went up and to the right, Willard was thrown out 25 or 35 feet as a hundred witnesses will testify."

Does anybody with common sense believe it took the tail of that machine 12 seconds to make a dive that would throw a man's body 25 or 30 feet? Is it not a practical certainty that it happened in fractions of a second?

Ovington says it is not dangerous because the plane of rotation is not changed quickly enough. Certainly the turns are not quick enough, ninety-nine times out of a hundred. Nobody disputes that. But why ignore the hundredth time when the turn *is* quick enough and the force is too strong for the controls and another of our birdmen dives to his needless death?

Ovington failed to understand the significance of the main features of the accident. In the first place a number of eye witnesses, himself included, state positively that after Willard had been thrown out, Miss Quimby succeeded in righting the machine but only for an instant, when it was again whirled nose downward and dove in a straight line for the water. Now if the fouled rudder cable caused the dive, as he claims, how could she have righted the machine? Then again with the rudder jammed to the left how could the machine have sailed *straight down* and avoided a series of spirals? It does not seem just clear? Does it?

If Mr. Ovington is an engineer he should have particularly noted several important points. He says Willard was thrown into the air 25 or 35 feet as though shot from a catapult. He also says the dip was caused by the controls. Therefore, if he possesses the rudiments of engineering knowledge he should know that the aeroplane would then turn about its center of gravity or lateral axis. As the passenger seat occupied by Willard was not more than 3 feet back of this axis, there could not possibly have been sufficient angular movement at this point to throw him out as described. I am confident that every competent engineer will bear me out in this statement.

These conditions of the accident completely disprove Mr. Ovington's theory.

On the other hand if, as I claim, the accident was caused by gyroscopic force in the motor, the entire machine would then turn about the center of effort of the motor which would be its exact center of gravity. Thus we see that the motor being the fulcrum of the lever, Willard would be 7 or 8 feet from the center of effort and in a quick dive it would not be impossible to throw him the 35 feet. Suppose that a slight wind gust caused a sudden dip in the front of the machine. A very slight, quick movement would have been sufficient to have aroused the gyroscopic force. Miss Quimby would naturally attempt to correct the equilibrium by raising her elevator, thereby accelerating the precession of the gyroscope and causing it to twist the machine to the left and downward. The severity of the twisting motion would be entirely dependent upon the speed of the previous motion that aroused it and judging from the terrific force exhibited I should say this must have been so quick that no human eye, one thousand feet below on the ground, could have detected it.

With this explanation it is easy to see how Willard could have been thrown that distance straight out from his seat, and, also, if one is familiar with the tremendous gyrating power of this force why the machine seemed to right itself.

Mr. Ovington went to great trouble to get affidavits supporting his claim about the machine swerving to the left. If he had read more carefully the articles of the several scientists who have warned against this peril, and particularly if he had ever studied the action of a gyroscope he would have known that under these conditions the machine always *swerves to the left* as it falls.

Chicago, Ill. RALPH M. PEARSON.

Wanted: Research on Gyroscopic Action

To the Editor of the SCIENTIFIC AMERICAN:

I notice that there has been some discussion in the SCIENTIFIC AMERICAN regarding the gyroscopic action of the rotating parts of flying machines. The Gnome is, without doubt, the most popular engine that we have to-day. This engine is of considerable weight and practically the whole of it revolves at a high speed in the same direction as the screw or propeller. There is no question about it, these high rotating parts do produce a very powerful gyroscopic action.

Some years ago there was a red hot discussion in England regarding the sinking of the torpedo-boat destroyer "Cobra." When I pointed out that there was no gyroscopic action, everyone imagined that I had "got my foot into it," as they said, but experiments showed that I was right after all.

I am sending you inclosed a cutting from the *Daily Mail*, which I think will serve to show the effect of a Gnome engine on a flying machine.

I am very strongly of the opinion that some experiments ought to be made to show the character and force of the strains that are set up when the machine is flying other than in a straight line. The experiments can be made at very little expense. All that is necessary would be to erect a rotating platform, rotating after the manner of a table lathe, that is, on a vertical axis. The engine and propeller would be mounted on this platform, not rigidly, but on what might be called trunnions perpendicular to the vertical axis. The machine should be so mounted that it could move freely on these trunnions, say thirty degrees in either direction. The trunnions should be as near the center of gravity as possible and the machine held in a horizontal position by spiral springs. If now we cause the motor to run at full speed and rotate the platform on its vertical axis, we shall find that the machine has a strong tendency to move on the horizontal axis, and it would be a very easy matter with a spring balance to find out how much it would require to hold the machine in a horizontal position while it is being slowly rotated on its vertical axis.

If someone would make these experiments in the States and they should be published in the SCIENTIFIC AMERICAN it would be of great value to everyone who is interested in the development of flying machines.

London, England. HIRAM S. MAXIM.

[The suggestion of Sir Hiram should be followed by one of the well-equipped technical laboratories of which we have so many in the United States. No one questions that gyroscopic force is developed when an aeroplane, driven by a single revolving-motor engine, makes a turn. The only question is as to the amount of this force. A practical demonstration along the lines suggested in this letter would provide exact data.—EDITOR.]

Lack of Aviation Enthusiasm

To the Editor of the SCIENTIFIC AMERICAN:

The undersigned wishes to make the following comments with reference to an editorial which appeared in the issue of September 21st of the SCIENTIFIC AMERICAN. The subject of this editorial was the lack of enthusiasm displayed in the United States in the progress of aviation, which showed itself glaringly in the failure of America to send a single machine across the line in defense of the Gordon Bennett Cup. In addition to the comments made by Mr. Charles A. Manley on September 28th, the undersigned wishes to offer the following suggestions:

The strongest motive which urges on the French people to perfect aviation to the highest degree attainable, regardless of cost, is their strategic relation toward Germany. To them the aeroplane naturally appears as an excellent weapon with which to establish a superiority over Germany, and great hopes are set upon this means of attack and defense. This of course forces Germany to follow suit and on its part to develop its aeronautic force to the highest possible degree. And the other European countries follow the example of France and Germany because they also have to reckon with the possibility of war, and the new weapon appears to them also as a very valuable means of carrying on warfare. Inasmuch as the United States are in the fortunate position of having no such powerful and hostile neighbors, but having on their borders only comparatively insignificant or else friendly nations, they have no occasion to pay the same attention to the new arm of war as is devoted to it by European nations.

In addition to the circumstances just referred to, there is another important factor bearing on the situation, namely, that in spite of all the improvements of the aeroplane of to-day, it nevertheless remains an unsafe mode of locomotion, and there seems to be no possibility of entirely overcoming this defect. Furthermore, the time of flight must necessarily always remain limited and can probably not be much extended beyond its present value.

The cause of these two defects must be traced to the necessity of using powerful motors and propellers. The consequence is that aeroplane flight has not become very general and has remained unpopular. In Europe, especially in France and Germany, the competitive efforts to improve aviation represent a kind of warfare, in which the lives lost are counted among the inevitable cost of war.

In a peaceful country, such as the United States, the causes which impel the European nations to competition in attaining the highest perfection in aviation are entirely lacking. If the military inducements did not exist in Europe, probably there would be even less progress there than in America. There is no lack of enthusiasm for the cause here, but the only system of aviation which can find extended application and success in this country is one which guarantees greater safety for the life of the passenger and a longer duration of flight, a system which, therefore, is better adapted for practical purposes and for sport. F. BIBERSTEIN.

Milwaukee, Wis.

[There is a great deal of sound reason in Mr. Biberstein's comment. At the same time we fear that he is a little too lenient to us as a nation in this matter. For the flights of the "Schwaben," representing, as they do, at least a semi-commerical undertaking, and the general interest which has been shown in them by the German people, prove clearly enough, that in Germany at any rate interest in aviation, however much it may be fostered by strategic consideration, has also a strong practical basis quite apart from its military *raison d'être*.—EDITOR.]

The Current Supplement

THE current issue of our SUPPLEMENT contains a number of articles which will be found of special interest. "Safety First" is the cry raised by R. C. Richards in dealing with the burning question of the Prevention of Railroad Accidents.—Mr. R. D. Andrews discusses some very remarkable properties of aeroplane-pairs arranged in tandem.—The problem of internal-combustion locomotives is one which is likely to receive increasing attention in the future, and is briefly dealt with in this issue.—An excellent review of recent progress in illumination, representing the report of a special committee appointed by the Illuminating Engineering Society, should prove of interest not only to engineers but to the general reader also.—Mr. C. A. Tupper describes a remarkable sixty thousand horse-power blast furnace gas engine plant.—We had occasion some time ago to give a preliminary report of Sir J. J. Thomson's new method of chemical analysis, in which the molecules are literally "weighed."—A most excellent detailed account of these experiments is now given by Mr. F. W. Aston of the Cavendish Laboratory, Cambridge, England.—The Fire Department of the French capital has recently been completely reorganized, the automobile equipment being brought up to the latest pattern. These innovations are described in a well-illustrated article.

Fig. 1.—View of the Jambon-Bailly studio in Paris.

Fig. 2.—The "pallette," in which the hues are prepared.

A Glimpse of a Scenic Painter's Studio

A Profession That Calls for an Intimate Acquaintance With Historic Conditions

By Dr. Alfred Gradenwitz

THE art of scene painting is one of the most interesting and at the same time exacting professions. It demands of its adepts, apart from their professional skill, a vast all-round education and knowledge of the most varied description. A scenic painter ought, in fact, to be well acquainted with the history of styles, dress, furniture, armor, etc., all of which should appeal to him as strongly as architecture proper. He should have an accurate idea of the habits of any epoch and the customs of any nation. Among his records, in his own professional library, should be included the very principle of the various forms of architecture, sculpture, painting, etc. In the case of modern landscape he should not be at a loss to choose the right scenery and, if necessary, go abroad to find on the ground the inspiration required for his work. The real artist among scene painters, of course, always records his impressions in a sketch book which in course of time will form a real storehouse of valuable scenery elements. Visits to the foremost museums of the world as well as a keen observation of nature and men will be required to develop his taste and to form the material on which his imagination may draw at the right moment. In fact, the ideal scene painter has to comply with more numerous and varied requirements than most persons engaged in other walks of life.

One of the most difficult tasks, previous to the design of a given set of scenery, is to read intelligently the author's manuscript. Many will be inclined to think that if a scene takes place in our day there will be no need for such imagination, in order to paint a village, a country road and cottage, a drawing room, plain or fashionable, etc. This is true enough if the painter be content with turning out such indifferent work as can be seen in most second-class theaters. The real artist, however, remembering that scenery often is a decisive factor in the success or failure of a piece, will go through the manuscript most carefully, taking notes every now and then and making the actors play in the scenery imagined by himself. Many minor details entailed by the dramatic action will have to be thought out in this connection. The execution of this work may be carried out best in a studio like that shown in Fig. 1.

Fig. 3.—Studying the details of a scenic setting at the Jambon-Bailly studio.

Fig. 4.—The draftsman or "tracer" marking the design upon a canvas.

After reading the manuscript, the scene painter first draws a rough sketch, fixing the "principles" of the scenery, with the pencil, pen, carbon, or crayon, but preferably with water colors and brush, thus allowing his imagination a wider scope. Much skill is required to produce even this first sketch, so that the painter may effectually defend his plans in discussion with the director and the author, both of whom have, of course, their own ways of looking at the matter. This sketch, which often is completed in an hour or so, will be used in producing a small sized model or "maquette," a miniature stage—similar to those put together by children with cut-out paper and wood—which is so designed as to give an adequate idea of the scenery to be produced. Any details are shown in the form of small pieces of cardboard cut out and fixed on a horizontal cardboard reproducing the floor of the stage. This is how any trees, houses, rocks, in fact, the whole of the scenery, are reproduced in a diminutive compass, inside a box opened in front and on the top, so as to insure adequate lighting effects (Fig. 3).

On this miniature stage the artist arranges his scenery. Here he sees on a reduced scale where the various parts of his work should be placed. He is in a position adequately to judge of effects, adding and cutting down, and altering any inconvenient arrangement. A "maquette," like a painting, should be the artist's personal work. Its successful design reveals the capacities of its author, and a poor "maquette" often foretells failure of the whole scenery. A good stage model of this kind, which may be a master-piece in itself, is most useful in arranging with the author and director any minor alterations that the case may require; the scales generally chosen are 3, 4, and sometimes 5 in 100. It is a welcome means for the painter to test his light effects, to ascertain the height of the ceilings and to check the perspective. In order to prevent any disagreement between the dimensions of the scenery and those of the actors, the foreground should always be painted in real dimensions.

About a hundred years ago the general practice was to trace the outlines of a

canvas on the ground, but to complete it standing up, in the position it was to occupy on the stage. Extensive walls as well as a complicated system of scaffolding therefore were required to paint the scenery.

While this practice is still followed in England and in some studios in this country, painting on the ground, a much more rapid process, has been found preferable nearly everywhere else.

In order, however, to enable the painter to work easily and without much bending over the canvas lying on the ground, all sorts of utensils fitted to the ends of long sticks are used. These utensils are the "brooms" and "brushes," the "ruler" and the carbon-holder.

The "brooms" are merely big painting brushes, round or square, such as those used by decorators, and are handled in an upright position. They serve to apply to the canvas the first general layers and are handled alternately from right to left, and left to right, with the two hands placed above each other, by long sticks kept vertically to the ground, so as to allow the paint to be laid on more vigorously. Taking up a considerable amount of paint, these brushes allow a large portion of the canvas to be painted most rapidly.

The "brushes" are painting brushes of variable thickness, used especially in painting the details of the picture; they are handled with one hand, the same as the long carbon-holder, used to trace a sketch in proper dimensions.

The draftsman, who by means of this carbon-holder and the long ruler with its stick, transfers to the canvas all the measures and profiles of the "maquette" (Fig. 4) is in French studios called "tracer" (*traceur*).

The "palette" (Fig. 2) is a sort of large box in which hues, taken from earthenware pots containing liquids of all colors, are prepared for laying on.

In tracing circles of large diameter, a pencil attached to the end of a string is used; for smaller circles large wooden compasses are employed. Of other tools invented by the ingenuity of scenic painters should be mentioned a sort of square box supported on two uprights connected by a horizontal handle, for use in transporting the color pots from one point on the canvas to another. Other utensils of the scenic painter are: the "duster," a long stick carrying at its end some strips of cloth, which is used in blotting out the carbon outlines and any errors made in tracing; a long wooden ruler carrying at one end a sharp point and at the other end an adjustable pencil, which also serves to trace, though in a much more perfect manner, any circles of large diameter, and, finally, a big square, 3½ meters in maximum length.

Oil painting is never used by the scenic painter. Apart from their prohibitive cost, oil colors would, in fact, make the scenery too heavy, and would dry much too slowly to allow the painter to walk on the canvas. Moreover, oil painting, on account of its brilliant reflexes, would be disagreeable to the eye. Nor does the scenic painter use benzine or varnish.

His colors are of a special kind, dispatched in barrels in the form of powders or pastes of all the hues of the palette. Powdered colors are dissolved in water and agglutinated by means of heated glue. Color pastes are more brilliant, but are apt to congeal at low temperatures. As soon as the color is prepared, it is poured into pots. Whenever large surfaces are to be covered, e. g., in preparing the priming, whole buckets of paint are poured out on the canvas by means of the very largest brushes. On drying, the glue fixes the color on the canvas. By varying the amount of water and glue, colors of any desired thickness can be obtained; a special advantage of these colors is their remarkable ease of handling and the minimal resistance they oppose to the brush.

Before using the canvas, the tracer, in order to facilitate his work, makes a drawing on paper in real dimensions, which is pounced on the canvas (Fig. 5). Some of the tracers are remarkably skilled and are most interesting to watch in touching up with the ends of their carbon-holders the curvature of a volute, or in designing a decoration, etc. They also mark with chalk those points where light effects should be obtained. Their task finally comprises the designing of the perspective, which in the case, for instance, of a complicated masonry is by no means easy. They go to and fro over the canvas with their slippers on, and seem even more at ease in drawing in their upright position than if they were seated at a table. The skill they acquire by practice is wonderful and it enables them to achieve real marvels. Tracers, like painters, should have a good knowledge of styles. Carelessness in their work is only too often responsible for failure of the whole painting, while nothing facilitates so much the painter's task as a satisfactory tracing.

After stretching the canvas out on the ground and fixing it by means of drawing pins, the first thing to do is to coat it with a white priming. When this is dried, the tracers transfer on the canvas all the different measures and profiles of the "maquette," using a special ink in marking any characteristic details. Only after the tracer's work is done and a framework of outlines obtained on the canvas, does the painter's task begin. He first applies, as on an oil painting, the fundamental layers reproducing the general outlines of the picture, always remembering that the colors thus used freely will lose much of their intensity in drying.

Any details are then brought out with the finer brushes, which on account of the size of the panel and its position on the ground is by no means an easy task. In connection with architectural interiors, some details of decoration have sometimes to be accentuated by means of a

(*Concluded on page 355.*)

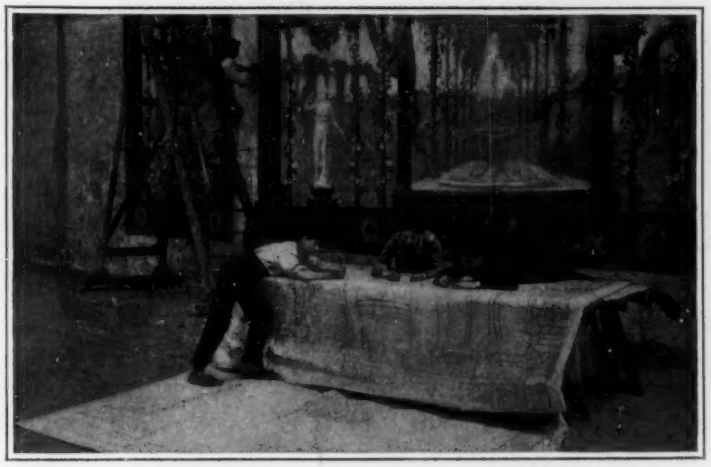


Fig. 5.—A theater curtain design, to be transferred to the canvas.

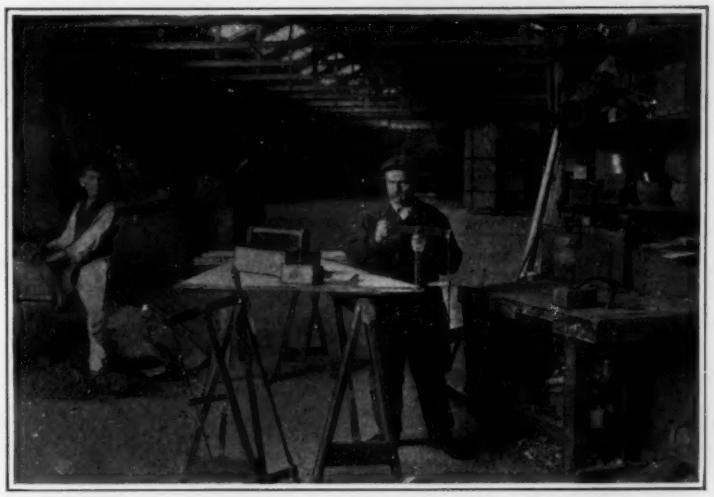


Fig. 6.—Joiner cutting the curved outlines of scenery frames.

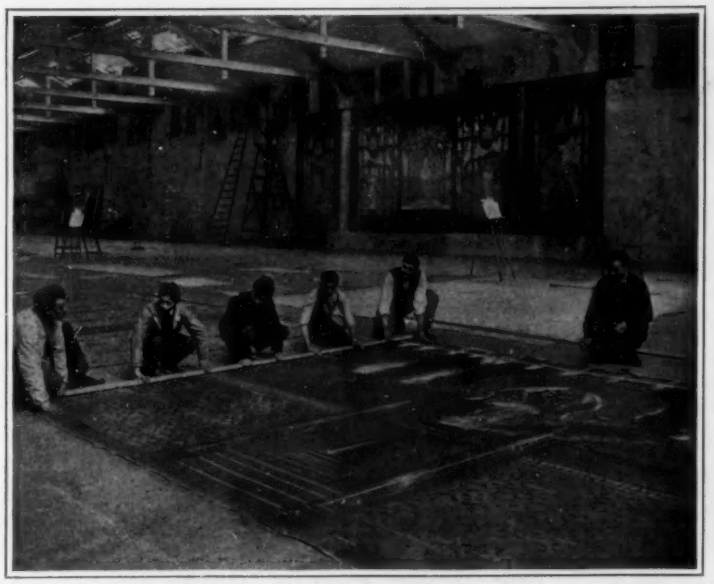


Fig. 7.—Rolling up a finished piece of canvas. Scenic effects tested on the wall.

Fig. 8.—Last retouches on the stage; the scenery having been installed.

Fig. 9.—Finished exterior view of a scene from the third act of "Faust."

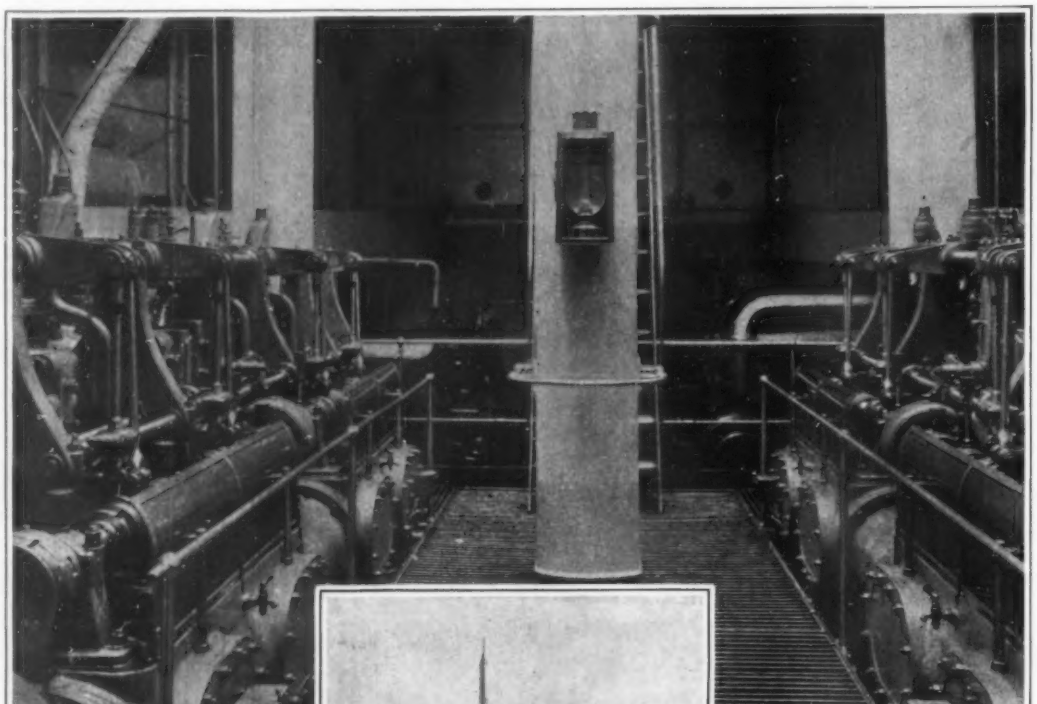
The Twin-screw Motor Vessel "Monte Penedo"

By Our Berlin Correspondent

THE twin-screw motor vessel, "Monte Penedo," recently built by Messrs. Howaldtswerke of Kiel to the order of the Hamburg-South American Steamship Company, in so far represents a most interesting new type of vessel as it is the first large transatlantic freight ship to be equipped with two-cycle Diesel motors.

The "Monte Penedo" is 350 feet in length, 50 feet in breadth and 27 feet in depth, her gross tonnage being about 4,000 registered tons and her carrying capacity about 6,500 tons. She has two continuous steel decks, a long poop and forecastle, a continuous double bottom and an elevated ballast tank, four holds, 6 watertight transversal bulkheads and two masts, and comprises the most up-to-date loading and unloading devices for the handling of goods up to 35 tons in individual weight. The dwelling rooms for the captain and officers are arranged amidships, and those for the machinists at the rear on the poop deck, whereas the sailors are accommodated below the forecastle and the engineers below the poop.

The "Monte Penedo" is operated by two reversible, four-cylinder, two-cycle, Diesel-Sulzer crude-oil motors of a total output of 2,000 indicated horse-power, which drive the vessel, at full load, at a speed of about 10½ knots. The auxiliary machinery comprises a 50 horse-power Diesel dynamo, a 50 horse-power compressor, an auxiliary steam-operated compressor, an auxiliary condensing plant, and a condensed water re-cooling plant. Most of the auxiliary machinery is operated by steam generated by an oil-fired auxiliary boiler. The steering gear is actuated by pre-heated compressed air. The oil bunkers are protected by special safety devices against any risk of fire, as well as against injury and leakage in the event of collision, so that all requirements with regard to the safety of the vessel are fully complied with.



Upper platform in the engine room, showing the valve mechanism of the two-cycle Diesel motors of 2,000 horse-power.

The "Monte Penedo," first large transatlantic freighter driven by two-cycle motors.

The Sulzer two-cycle motor installed on the "Monte Penedo" show some important advantages over the four-cycle motors of the recently-built motor vessels "Selandia" and "Christian X." They are, in fact, considerably smaller and lighter with an equal oil consumption, and as their space requirements are less, the space and weight left for the installation of the cargo are considerably greater. Moreover, two-cycle motors are cheaper and simpler in design, so that the cost of repair is lower. It is claimed that there is a certain advantage in two-cycle motors over four-cycle motors because of their superior maneuvering capacities.

In order to give an idea of the advantages to be expected from the adoption of such motors, it may be said that the saving in fuel as compared with quadruple expansion engines during a voyage of 13,500 nautical miles from Hamburg to Buenos Aires, will be 1,073 tons, and on the home voyage 537 tons, i. e., an average of 805 tons, while the saving as compared with triple-expansion engines is 1,323 and 662 tons, respectively, the average being 993 tons. When adding this to the saving in weight due to the smaller weight of Diesel-Sulzer motors, the total saving or surplus capacity works out as follows: As compared with quadruple-expansion engines, a surplus capacity of 975 tons, i. e., about 15 per cent, and as compared with triple-expansion engines, a surplus capacity of 1,163 tons, or 18 per cent.

During the recent trial trip a speed of 13.8 knots was obtained.

The "Monte Penedo" has just started on her maiden voyage to South America.

Tokio Buys Motor Fire Engines.—The Japanese capital has just installed eleven motor fire engines, in an attempt to reduce the terrible annual loss by fire in that city. The cars are driven by gasoline, while the pumps are worked by steam.

The Improvement of Fifth Avenue

FIFTH AVENUE, New York, is a street of national interest. It is the most exclusive shopping street of the nation's largest city, lined with the highest priced shops displaying signs of famous foreign houses. In spite of many fine buildings, the avenue, outwardly, falls short in many ways of its business reputation. Many of the stores are modified brown stone dwellings.

The recent widening of the roadway of Fifth Avenue from forty to fifty-five feet, and the wholesale removal from the sidewalks of building encroachments, have greatly increased the traffic capacity of the avenue. Four lines of vehicles can now move along instead of two or three. Recently a municipal commission has recommended still more improvements, which are on the eve of being carried out, viz., further widening of the roadway, redesigning of squares, tree planting where possible, better lighting, isles of safety, public cab stands, limitation of the height of buildings, and reduction of sidewalk congestion.

There is one side to Fifth Avenue of which no marked improvement has yet been attempted. That is the engineering side. True, the asphalt pavement is now laid on a concrete base, and every effort is being made to get the surface durable and free from defects. The street is very smooth in the main, and is kept well cleaned. The chief defects are those due to past practice. The question is: Would it be worth while to remedy them?

The most noticeable shortcoming inherited by Fifth Avenue from the past is in its surface drainage. The street has very little slope from the center to the gutters, and the gutters have very little slope toward the catch basins; with the result that little pools of water remain after rains, and even for some time after sprinkling. These pools, though injurious to the asphalt, are not objectionable to the public except when they occur at street crossings, which is very often the case, owing to the lack of slope of the street.

During a rain storm the defective drainage is most apparent. At such a time streams of water are often encountered in crossing the street, although the best highway practice requires that no water should flow past a street crossing. A study of the location and frequency of catch basins along Fifth Avenue shows why so much water is seen. Comparatively few catch basins are found, and these are almost always located on the street corners, where the water to reach them must pass two crosswalks. This old custom has the further objection of causing the curb to be highest where it is most used. It is considered the best practice at a street junction to have the highest point of the gutter exactly at the street corner, the water flowing down each street to two catch basins close by. If Fifth Avenue were constructed to-day along modern lines, there would be one hundred and sixty catch basins to a mile, or eight at every street intersection. Instead, there are only from eighteen to thirty found per mile.

Again, the gutter-mouths leading into the catch basins are often small, and the gratings much clogged with street sweepings. Sometimes the street surface slopes the wrong way, so that water flows by a basin and by a cross street. Instead of having basins every 200 feet, which is considered desirable in the built-up sections of some cities, as long a distance as 1,500 feet has been found without a catch basin. Moreover, there are no catch basins on the cross streets, though these are 800 feet long, west of the avenue. Still another place where water lingers is in the covers of certain catch basins on the sidewalks, and certain manhole covers in the street, owing to recesses in the covers.

The final question is whether it is worth while to reconstruct city streets according to modern standards. Against doing so is the cost, involving in the case of Fifth Avenue the raising of the level of the street center, changing gutter grades, building all new catch basins, in new locations, etc. On the other hand, reconstruction of everything in a city is necessary with some frequency. Should not an avenue of the importance of Fifth Avenue be kept up more nearly to modern standards? The traffic will increase more and more, making radical alterations more difficult in the future. The desirable thing would seem to be to begin the reconstruction of the avenue, half the width and one block at a time. Pipe galleries should be introduced under each side of the street, as is done with new streets in London. Manholes should be located so as not to be in the way of travel when they have to be opened. Iron covers should be banished, and non-slipping covers adopted which will not hold water.

Such changes should not be regarded as unnecessary refinements. It is necessary in private business to keep adopting new methods and new equipment. Why not in the public business as well? Some American cities are doing this, but too often it is along only a few lines. Every municipal department should be encouraged to study out improvements, and ideas should be exchanged even more than now with other cities.

Non-astringent Persimmons

THE popular demand for the large and beautiful Japanese persimmon has been retarded by the marked astringency of the fruit when firm and tempting to the eye. Moreover, if the fruit is allowed to ripen until the "pucker" is lost it becomes soft and mushy, decaying very rapidly. In Japan they have for years practiced the art of removing the "pucker" by sealing the firm fruit in barrels which have been rinsed with "sake," a sort of Japanese beer. Our Bureau of Chemistry finally took the hint and have recently found that the same effect is obtained by keeping the persimmon in carbon dioxide from three to five days. Some varieties come out of this "processing," as it is called, as firm as an apple and may be peeled and eaten like an apple with great satisfaction. Our native American persimmon, however, does not respond to this treatment. The fruit grows easily on the Gulf coast, and the demand is increasing. When the growers and retail dealers learn that persimmons may be put on the market in firm, rosy and edible condition the industry will take on new life.

An Electric Stove

By Frederick E. Ward

THE convenience and utility of electric heating apparatus have so long been recognized that were it not for the high cost of electric energy, as compared with coal and gas, hardly any housewife could now be persuaded to cook with any other than an electric stove. But even if it does cost a little more for power, many of us are glad to use it occasionally merely because of its convenience. For those who have electric current in their homes and would like to make such occasional use of it, and yet who are discouraged from so doing by the rather high cost of an electric stove, the following description shows how one of these can

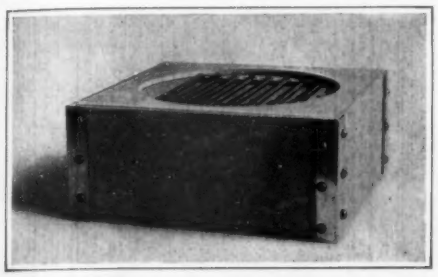


Fig. 1.—The stove complete.

be made at home at a cost for materials of but a fraction of the regular price of the commercial article.

An electric stove is a very simple and efficient piece of apparatus. It is practically nothing but a piece of wire which is heated red hot by the passage of the current through it, and it is easily made because success depends more on the selection of proper materials than on skillful workmanship.

As shown in the photograph in Fig. 1, the body of the stove consists of a fireproof box about seven inches square and three inches high. This may be built up of four pieces of asbestos board, about ⅛ inch thick, fastened together by corner pieces bent up from sheet copper or brass held in place by small brass machine screws and nuts. Asbestos shingles also serve the purpose well, and these are cheap and easily obtained from dealers in builder's materials.

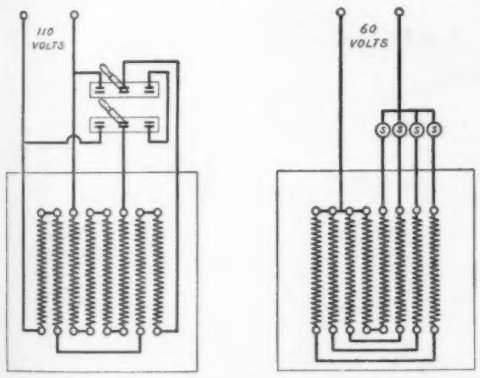


Fig. 2.—Diagrams of connections.

The essential part of the apparatus is, of course, the heating element, shown more clearly in the photograph in Fig. 3. The base of the heater is a square of the asbestos board cut to fit inside the box, and having four strips of the same material riveted to it so as to form a sort of picture frame four inches square inside. Across this frame are stretched the eight pieces of wire which form the heating element itself.

Of the many different makes of wire on the market one of the best is the "Nichrome," made by the Driver-Harris Wire Company, of Harrison, New Jersey. The heater shown in the photographs was made of gage number 22 Nichrome wire, which has a resistance of

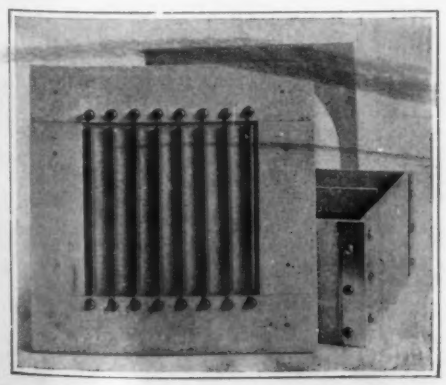


Fig. 3.—The stove partly disassembled.

about one ohm per foot. The weight of wire actually used in this stove was only 1¼ ounces, but it is advisable to order at least one half pound of the wire, as wire-drawing companies do not, as a rule, care to book orders amounting to less than one dollar.

The eight helices for the heater are each formed by winding 135 turns of the wire closely around a rod just one eighth of an inch in diameter, on which the turns will cover a length of 3⅜ inches. The rod is then removed and the ends of the wire bent up into eyes, by means of which, after a slight stretching, they may be attached to the asbestos frame by small brass machine screws fitted with nuts and washers. If each screw be provided with two nuts on the back the electrical connections are very conveniently made by clamping pieces of No. 16 copper wire between the nuts.

Diagrams of connections are shown in Fig. 2 For 110 volts the arrangement shown provides three different heats, two double-throw single-pole switches being employed. When both blades are closed to the left the heater develops full heat, and consumes about 880 watts. Opening either switch reduces this to one half, and closing both blades to the right gives one quarter heat. For 60 volt isolated plants another scheme of connections is shown, in which the heater is divided into four sections, each under the separate control of its own snap switch.

The heating element is best supported in the box by means of strips of asbestos board riveted on the inside. The wires must be low enough down so that metallic cooking utensils cannot touch them and cause a short circuit. If the cooking utensils to be used are too small to cover the entire top of the box it is essential to provide a top piece of asbestos board, as shown in Fig. 1, to cover the open corners and prevent waste of heat.

To make the stove ready for use as a radiant toaster, it is sufficient to cover the top with a square of coarse wire cloth upon which to lay the slices of bread.

Studying Prismatic Colors of Incandescent Lamps with a Reading Glass

By Stuart K. Harlow

THE following interesting investigation of the different colors of the spectrum of the filaments of the tungsten and carbon incandescent lamps was carried out with a 2¼-inch diameter magnifying glass.

The first lamp tested was a 40-watt Mazda lamp, suspended from the ceiling in a white corrugated china shade. The reading glass was held horizontally below the lamp and at a distance of 12 to 16 inches, with a 12 by 12-inch square sheet of white enameled paper held parallel to the reading glass and at the proper focal distance from the lens. The superior color was found to be white, which was fringed with yellow, orange, red, green, blue, and violet. All these colors do no appear in the scene at one position of the lens, because the principal focal distances in the double convex lens are different for different colors, being less for violet than for red. This phenomenon is known as chromatic aberration. It is eliminated in our particular experiment by moving the hand lens back and forth, thus varying the focal distance. By holding the lens at an angle to the incandescent lamp, the illuminated filament appears inclosed in its bulb and shade.

The next lamp tested was a 16 candle-power 50-watt carbon filament incandescent. The lens was held in the same position as above; the filament appears as a broad incandescent band, in which yellow, together with white are the superior colors, red being present to a greater degree than it is in the tungsten lamp. This incandescent band was fringed with orange, red, green, blue, and violet.

A kerosene oil hand lamp with wick and the ordinary glass chimney, when the lens is held parallel to the flame and at a distance of 3 feet, its spectrum appears as yellow with slight traces of white, and orange, red, and green around the edges. When the lens is held at a distance of 12 feet from the illuminant, the spectrum appears as a small circle three-sixteenths in diameter, the center of which is brown, but still showing traces of red, orange, yellow, green, and blue.

It might be interesting in this article to mention an observation of the New York Testing Laboratories exhibit at the 1909 Chicago Electrical Show at the Coliseum. It consisted of three projection machines mounted with suitable lenses to project the arc spectrum of the flaming arc, magnetite arc, and carbon arc on a canvas screen a few feet away. The image of the flaming arc showed yellow, orange, red, blue, and purple; magnetite arc, white, yellow, and blue; and the carbon arc, green, yellow, orange, and purple. The carbon arc appeared thin and dim on the canvas screen.

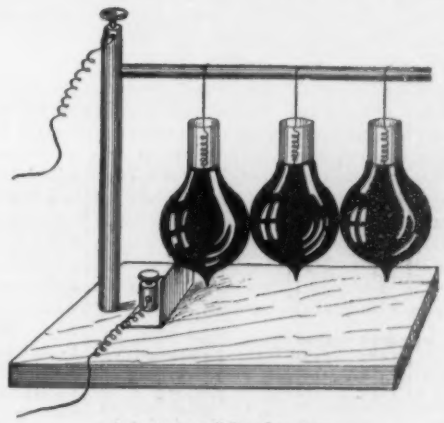
Leyden Jars Made of Incandescent Lamp Bulbs

By Maxwell Epstein

TO give best results, a Leyden jar must have a good dielectric with little thickness. Ordinary burnt-out incandescent lamps—16 candle-power or larger—can easily be converted into excellent Leyden jars. The best bulbs can be selected by rubbing with silk in a dark room. Those that glow most make the best jars.

A slit is cut across the threaded metal top with a hack saw, and the thin brass is peeled off with a pair of pliers. The leading-in wires can now be easily cut, the top taken off, and the bulb cleansed of the insulating compound. The groove at the junction of the in-going glass tube and the bulb, is scratched with the sharp point of a broken file moistened with turpentine, until the tube with the filament can be pulled out.

The bulb is now coated outside with tinfoil to within 1½ inches of the top, and filled inside to the same height with scraps of tinfoil. A piece of No. 20 B. & S. copper wire, hooked at one end, is thrust



A battery of Leyden jars.

through a half inch cardboard disk and into the bulb. The top is now sealed with sealing wax.

The amalgam used for coating mirrors is preferred to the tinfoil inside, if it can be obtained or made as described in the SCIENTIFIC AMERICAN of April 8th, 1911.

By hooking these jars on a brass rod and pushing them together, as shown in the figure, excellent variation in capacity can be secured for the closed circuit of a wireless transmitter.

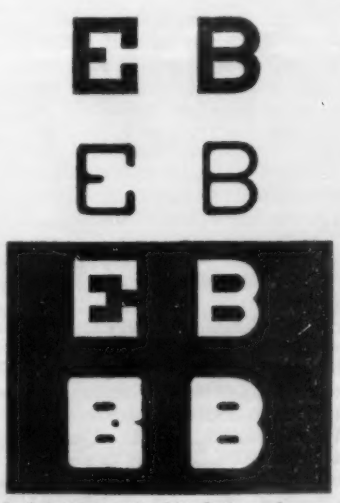
Relative Clearness of White and Black Letters

By Samuel W. Balch

THERE is a general tendency on the part of railroads to adopt signs with white letters on a black background, not realizing that the black letter on a white background is easier to read and can be seen at a greater distance. This follows in an interesting way from the structure of the retina of the eye. The impression of a letter at the limit of vision is received on the ends of a small bundle of nerves which convey to the brain a sort of mosaic impression.

A nerve can only transmit to the brain information as to whether or not a ray of light is falling upon it and when a nerve is partly in the light and partly in darkness the sensation is the same as though all of it was in the light. It follows, therefore, that all nerves on the dividing edge between any black and white area transmit the sensation of light so that all white lines and white areas appear wider and all black lines and black areas appear narrower than they really are.

The two black letters in the illustration grow thinner at the limit of vision and are still recognizable, while at the same distance the two white letters grow thicker and cannot be distinguished. There are circumstances when it is necessary to use white letters, but in such cases legibility will be improved if they are made with a thin stroke and strongly lighted. Black letters are more distinct if made with a heavy stroke.



How black letters and white letters change at the limit of vision.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

Notes for Inventors

A Toy Puzzle.—In a patent, No. 1,038,190, Waldemar J. P. Olsen of Brooklyn, N. Y., presents a patent in the form of an egg-shape shell within which is a tilting plate and a weight is movable on the plate and operates in connection with small balls to secure a balancing of the shell under certain conditions.

Cork Articles from Granulated Cork.—In patent No. 1,035,146 Louis L. Bentley of Beaver Falls, Pa., assignor to Armstrong Cork Company, of Pittsburgh, presents a method in which granulated cork is preheated to a temperature below the melting point of the cork resin and is then fed while hot into molds. Pressure is applied to the cork in the molds and the cork is baked while under pressure high enough to melt the resin. This resin as it cools cements the granules together.

Increases Butter Yield from Milk.—A Hamburg, Germany, man, Adolf Wilhelm Karl Witte, in a patent, No. 1,039,627, describes a process of treating milk and cream to secure an increased yield in butter and in which he cools the material to a temperature somewhat above freezing point and maintains it at such temperature for about twenty-four hours and then quickly warms it to a temperature of 18 to 20 deg. Cent., adds a souring generator or "starter" and immediately churns the material when it is ripe.

Utilizing Moving Pictures in Target Practice.—We are constantly learning of new uses for moving pictures. Now James Paterson of London, Eng., in patent No. 1,035,811 provides a target divided into recessed sections with means in each section for completing, by contact, electric circuits, and moves the target behind the picture screen, synchronously with the object to be fired at. An indicator is arranged at the firing point and is operated electrically from the target so that as a shot is fired it can be determined instantly whether a hit has been made.

A Machine for Making Bale-tie Buckles.—Ezra A. Frantz of Weatherford, Texas, assignor to Frantz Buckle Company of that place, has secured a patent, No. 1,034,007, for a machine for making bale-tie buckles in which there is mechanism for feeding the wire and for cutting it off and a means operates at a right angle to and across the path of the feeding mechanism to give one bend to the wire while another means operates in the direction of the feeding mechanism to give another bend to the wire and a final buckle forming means operates at an angle from the opposite side of the movements of the two bending mechanisms and the feeding, bending and forming mechanisms are operated in proper sequence.

New Patent Legislation in New Zealand.—A new act relating to patents, designs and trade-marks went into effect July 1st, 1912, in New Zealand. The new act differs from the old chiefly by the inclusion of a provision that any patent not worked in New Zealand within four years from the date it is granted, or within two years after the commencement of the new act, may be revoked by the Supreme Court on the petition of the Attorney-General or upon the petition of any other person with the leave of the Attorney-General. The American consul suggests that it is ordinarily the part of wisdom for American manufacturers whose goods are suitable for New Zealand and who intend to introduce them in such country, to secure New Zealand patents as otherwise imitations may be made by the New Zealanders, many of whom possess mechanical ability of a high order, and the spirit of invention is such that it often causes improvements on imported inventions.

Legal Notes

Patentability on Interference Appeal.—The Court of Appeals of the District of Columbia in the case of Hopkins v. Cleal, Cleal v. Hopkins, has held that on an appeal from the decision of the examiner awarding priority, the question of patentability of the issue will not be considered.

The Importance of Diligence.—The Court of Appeals of the District of Columbia rarely loses an opportunity to emphasize the importance of diligence on the part of an inventor. In the recent case of Courson v. O'Conner, O'Conner conceived the invention in November, 1908, and immediately set about reducing it to practice and filed his application on February 4th, 1909. Courson who had conceived the invention in 1898 made devices and tested them; but such tests were insufficient to establish a reduction to practice. The last of these tests was just prior to O'Conner's conception. Courson did nothing further with the invention until his application was signed on January 19th, 1909, which application was not filed till February 8th, 1909, and the Court held that Courson had every facility at hand to enable him speedily to reduce his invention to practice or file his application at a much earlier date, he was lacking in diligence, and that priority was properly awarded to O'Conner. The decision goes on to quote what Mr. Justice Robb said in a previous case to the effect that there is no arbitrary rule or standard by which diligence may be measured, the sole object of the law being to mete out the fullest measure of justice, and each case must be considered and decided in the light of the circumstances of that case. The nature of the invention, the situation of the inventor, the length of time intervening between conception and reduction to practice, the character and reasonableness of the inventor's testimony and that of his witnesses—are all important factors in determining the question of diligence.

Trade-mark Notes

A Trade-mark Opposition.—In the case of Consumers' Company v. Hydrox Chemical Company, Assistant Commissioner Tennant has decided that the opposition was properly dismissed since peroxide of hydrogen does not constitute goods of the same descriptive properties as distilled water nor merchandise of such character as to come within the natural expansion of the previous business of the opposer.

Difference Between Trade-mark and Patent Interferences.—In pointing out a distinction between a trade-mark interference and a patent interference, Mr. Justice Robb of the Court of Appeals of the District of Columbia has said: "In a trade-mark interference proceeding, the issue which the Commissioner is called upon to determine is not merely one of priority, as in a patent interference proceeding, but involves any issue that might be raised in an *ex parte* case. (*In re* Herbst, C. D., 1909, 333; 141, O. G., 286; 32, App., D. C., 565.)"

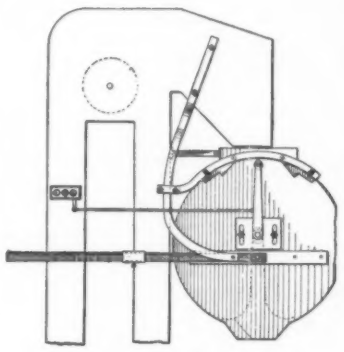
Trade-mark Applied to Publications.—In the case of Chilton Printing Company v. The Class Journal Company, Assistant Commissioner of Patents Billings has decided that the words *The Automobile Trade Directory* as applied to applicant's publication must be held to constitute a valid trade-mark, these words not being so wholly descriptive of the publication as to fall within the prohibition of the statute; also that the title *The Automobile Trade Directory* is not so similar to the title *The Cycle and Automobile Trade Directory* as to be likely to cause confusion in the mind of the public when applied to the same class of goods.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Of Interest to Farmers.

AUTOMATIC GRAIN WEIGHER.—E. L. ADAMS, Edgar, Clay Co., Neb. This device is operated automatically by the weight of grain it receives. It comprises a hollow vessel with an inlet at one end and an outlet at the other, and comprising means by which grain can enter the vessel until its limit of capacity is reached. Means also provide for the automatic discharge of the grain, and it

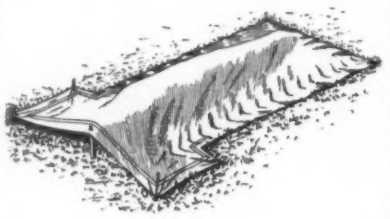


AUTOMATIC GRAIN WEIGHER.

passes continuously into the receiving vessel at one end and is delivered at the other, being retained long enough to actuate the mechanism which controls the outlet, and to register the times the outlet mechanism is actuated in this way, so as to indicate the measure of the total quantity of grain passing through the weigher. A side view of the device is shown in the illustration.

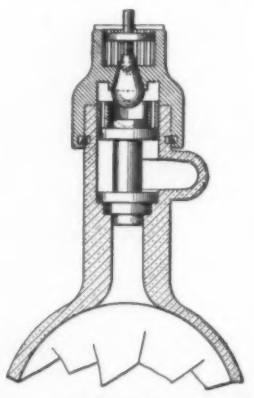
Of General Interest.

SLEEPING BAG.—G. W. GAIL, JR., 1614 Park Ave., Baltimore, Md. This invention provides an absolutely waterproof bag designed particularly for out of door use, as by campers. It prevents the entrance of any water at the head of the bag, and while excluding water at the head provision is made for proper ventilation. The occupant may enter the bag conveniently and blankets may be held in proper position with the bag, and a mosquito net may be conveniently attached at the head portion in a way to perfectly exclude insects. The illustration shows the bag staked to the ground, and in position for use.



SLEEPING BAG.

BOTTLE STOPPER.—H. T. RAY, 6 Warren St., Hudson, N. Y. This invention relates to improvements in stoppers and measuring devices for dispensing receptacles, and has for an object to provide a structure which will dispense predetermined quantities of liquid. A further purpose is to provide a valve mechanism acting as a stopper for bottles and



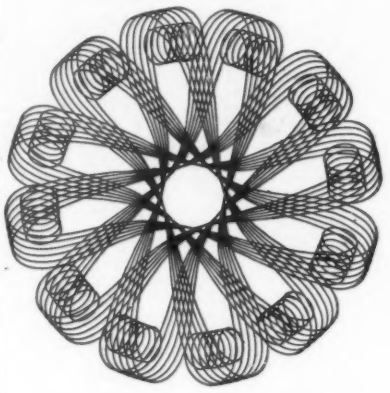
BOTTLE STOPPER.

the like, from which liquid is designed to be dispensed, which will permit the drawing of successive predetermined quantities of liquid from the receptacle, but will resist any refilling of the receptacle through the discharge point. The engraving shows a longitudinal vertical section through the invention as applied to a bottle.

LEAK STOP FOR LEVEES, DIKES, ETC.—M. M. NEAMES, St. Patrick, La. This invention is an improvement in protecting covers for levees, dikes, etc., in the nature of a revetment, designed especially for preventing breaks or crevasses because of the leakage of water through craw-fish and musk-rat holes or because of other defects in the structure.

HAND BAG.—H. COHN and P. BERMAN, 55 2nd St., Manhattan, N. Y., N. Y. This invention is an improvement in bags which are provided with pivoted U-shaped clips or clasps adapted to hold the jaws of the bags securely closed when the latter are suspended by the handle. The clasps are pivoted to one of the jaws and held from sliding laterally by a loose sleeve applied to the pivots.

DEVICE FOR MAKING DESIGNS.—L. L. ALLEN, L. B. 701, Atlanta, Ga. This invention relates to devices for making designs, and the object is to provide one having a bar carrying a marking member which contacts with a member secured to a pivoted table so that when the table is rotated, and one end of the bar is articulated to a rocking plate, and the other end engages a guide, the reverse motion of the rocking plate will be instrumental in producing designs pleasing in character. Means provide for articulating the bar to any one of a plurality of points on the rocking plate to adjust the position of the guide relating to the pivot point of the table, and to articulate an end of the bar to a member having continuous rotary movement instead of to the rocking plate. The engraving pictures an example of the design work of this invention.

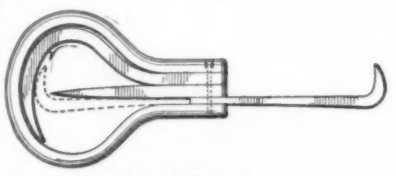


EXAMPLE OF DESIGN DEVICE WORK.

MAIL BAG AND BAG SUPPORT.—H. T. COOK, 332 So. Michigan Ave., Chicago, Ill. This invention has particular reference to a bag with means for supporting the bag in open position, particularly within a letter box, so that the letters drop directly into the bag, it being only necessary for the collector to substitute an empty bag for the bag removed. This also avoids unnecessary and frequently injurious handling of a mass of letters incident to removing them from the box in the ordinary way.

Hardware and Tools.

COMBINATION TOOL.—REV. C. BAUER, Clara City, Minn. In the accompanying engraving one of the implements of the tool is shown in operative position, and in a folded or inoperative position in dotted lines. The handle is formed with a looped end having engaging arms normally tending to move toward each other, between which the ends of the respective tools or implements are placed.



COMBINATION TOOL.

A pivotal pin is passed through all of the implements so that the same swing on the same pivotal center and may be moved in and out as desired, the respective implements being provided with projections co-acting with suitable sockets for locking the implements in either a folded or an unfolded position.

FOOT POWER VISE.—G. E. CALLAWAY, care of J. M. Bradley, Sec'y, Jonesboro, La. This invention has for its purpose the provision of an automatically operating device wherein the jaws are counterbalanced to open of themselves, and the operating mechanism is counterbalanced to return to original position when released.

PIPE REAMER.—D. M. HATTON, Burnett's Creek, Burnettsville Station, Indiana. An object here is to provide a device of a relatively simple nature for reaming pipes in which the power required is reduced to a minimum. The invention provides interchangeable pipe holding parts to accommodate pipes of various size, these parts being capable of quick application to the main supporting frame or removal from it.

ANIMAL TRAP.—J. F. WINKLER, P. O. Box 86, Dollar Bay, Mich. This invention provides a construction whereby the setting of a trap may be rendered automatic in so far as the engagement of the striker and its latch. A base and a bait carrier are constructed with

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a view to enable the operator to move the bait carrier into engagement with the latch member, when setting the trap, without danger of his fingers being caught by the striker.

INVISIBLE HINGE.—E. ZUCKERMAN, 395 Kimball Ave., Yonkers, N. Y. This invention provides an invisible hinge for use on doors, boxes, pianos, furniture and other articles and devices, and arranged to be invisible when the door or other movable member is in a closed position, and provides a space between the movable and the fixed member when the door is opened.

Household Utilities.

COOKING APPARATUS.—W. E. BAXTER, care of Varbe-Frazier Co., Ltd., Louisville, Ky. The construction in this case is in the nature of a combined cooking and heating stove and combined house and camp (or portable) stove. The invention provides a non-breakable crate and support adapted to inclose the stove proper for shipment, carrying by hand or storage for the stove proper when the crate is placed below the stove proper.

WASHTUB.—J. J. REILLY, 161 S. 8th St., Newark, N. J. The more particular purpose here is to provide a tub having a special form whereby it is adapted to be used in connection with a wringer so located within it that the combination of tub and wringer presents a number of advantages in the conjoint use of these parts.

LEG REST FOR ROCKING CHAIRS.—L. AIME, 25 Haig St., and J. STENGER, Jersey City, N. J. For the purpose of this improvement use is made of a leg rest provided with rockers and connected with the rocking chair to support the leg rest in upright position, and to allow of rocking the leg rest in unison with the rocking chair.

Machines and Mechanical Devices.

DOOR MECHANISM FOR ORE POCKETS OR SIMILAR RECEPTACLES.—R. B. PEARSON, 461 London Road, Duluth, Mich. The principal purpose here is to so construct the door and attached mechanisms as to provide an efficient door action which will be semi-automatic in opening and comparatively easy of closure against a head of ore or other material in the pocket when it is desired to stop the flow of the same.

LOOM FOR WEAVING GAUZE.—E. K. GEIER, care of Scholer, Duplan Silk Co., Hazleton, Pa. The object here is to produce a loom in which the needle reed is positively moved in fixed guides, and in which the flexing reed is located between the needle and the warp beam, and is positively reciprocated in a fixed guide in parallel relation to the needle reed; and a further object is to do away with the necessity of using any harness to manipulate and guide the threads.

Pertaining to Vehicles.

RADIATOR SHIELD.—F. F. BASSETT, Lawrence, L. I., N. Y. This invention pertains to a shield of a type used in automobiles, and is adapted to cover a portion of the radiator and protect it from the cold, so as to prevent an excessive cooling of the water in the radiator, and also to prevent the freezing of the water when the radiator is not in use.

Designs.

DESIGN FOR A TOILET POWDER DISPENSER.—E. OLDENBUSCH, care of Kronheimer & Oldenbusch, 366 Butler St., Brooklyn, N. Y. In this ornamental design for a toilet powder dispenser the body is of a narrow shaft-like form with a small round shaped mirror placed at the top end of the article.

DESIGN FOR A COMBINED KNIFE AND FORK.—M. S. HEWITT, Georgetown, Tex. In this ornamental design the article comprises a slightly curved handle to a knife blade of modified sickle form at the point of which and at right angle to the blade extends a short broad four-pronged fork.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The "Immortality" of Tissues

(Concluded from page 344.)

diminution after a certain age until the growth altogether ceases, and the size of the animal is determined. But it was found by subjecting these artificial growths to washings in salt solution that the mass was *fifteen times greater at the end than at the commencement of the third month, showing that they do not grow old at all!* In the artificial growth the problem of senility and death is solved! It was the announcement of this "permanent life of tissues" that caused such a furor in Paris last summer, and several eminent scientists to demand ocular demonstration, because "the discovery, if true, constituted the greatest scientific advance of a generation."

The following summary of this interesting and vitally important and epoch-making work of Carrel is translated from an article published in Paris recently by Prof. Pozzi,* who witnessed the experiments:

"Carrel found that the pulsations of a fragment of heart, which had diminished in number and intensity *or ceased*, could be revived to the normal state by a washing and a passage. In a secondary culture, two fragments of heart, separated by a free space, beat strongly and regularly. The larger fragment contracted 92 times a minute and the smaller 120 times. For three days, the number and intensity of the pulsations varied slightly. On the fourth day, the pulsations diminished considerably in intensity. The large fragment beat 40 times a minute and the little fragment 90 times. The culture was washed and placed in a new medium. An hour and a half after, the pulsations had become very strong. The large fragment contracted 120 times a minute and the small fragment 160 times. At the same time the fragments grew rapidly. At the end of eight hours they were united and formed a mass of which all the parts beat synchronically.

"Carrel then tried to preserve three fragments of heart in a state of functional activity for several months. One of the three experiments will be described.

"On the 17th of January, 1912, a fragment of the heart of an embryo chicken of seven days was placed in plasma. It grew rapidly in a thick crown of conjunctive cells. At the end of some days, the pulsations, which were regular and strong at the beginning, grew feeble and ceased completely. For more than a month, the fragment remained immobile. On the 29th of February, the culture which had been subjected to fourteen passages was dissected, and the central fragment was placed in a new medium. After the fifteenth passage, it was observed to contract rhythmically, and that the pulsations were as strong and as frequent as on January 17th. The number of the pulsations was from 120 to 130 per minute. During the months of March and April, the small fragment of heart continued to beat vigorously at from 60 to 120 times per minute. As the growth of the conjunctive tissue became more active, it was necessary before each passage to extirpate the new connective tissue that had formed around the muscle. On the 17th of April the fragment beat 92 times a minute. The contractions were regular and agitated all the mass of tissue and the neighboring part of the middle of the culture. On May 1st, the pulsations became more feeble. They were then subjected to their thirty-fifth passage. In the course of the manipulation, the muscular tissue was stretched and torn. The rhythmic contractions definitely ceased."

Experiments to date seem to establish that the connective tissue, at any rate, is "immortal."

From this research, it is possible to arrive at certain logical conclusions, which, however, it remains for the future to confirm. One, and the most important, is that the normal circulation of the blood does not succeed in freeing all the waste products of the tissues, and that this is the cause of senility and death.

* "Vie Manifestée Permanente des Tissus," *La Presse Médicale*, p. 532.

Were science to find some way to wash the tissues in the living organism as they have been washed in these cultures, man's life might be indefinitely prolonged.

A Scenic Painter's Studio

(Concluded from page 849.)

special mordant on which gold foils are brushed.

Movable scenes are dealt with in the same manner as the large background scenery. The canvas used in this connection is stretched out on special woodwork frames made by the joiner (Fig. 6). In order to facilitate the shifting of these frames special importance should be attached to making the frames as light and substantial as possible; they are supplied to the scenic painter on his own plans (sometimes in conjunction with the theater foreman).

The making of scenery rendering artistically cut foliage, tendrils, and similar fine details is an especially difficult task. The following process has been of late adopted in this connection: After painting the scenery and cutting out its outline, it is turned around and lined with a fabric consisting of light meshes of black yarn. This fabric is cut to the proper dimensions and coated on the back with heated glue. Before the latter has dried, small strips of tissue paper of different breadths (in accordance with the shape of the leaves) are applied, thus obtaining a substantial whole.

In order to allow the effects of scenery to be tested after completion, an observation bridge commanding a good view of the canvas is generally installed at a height of 15 to 20 feet on one of the walls of the studio (Fig. 7). Movable scenery need only be set up vertically, in order to give the same impression as on the stage (apart from lighting effects), which facilitates the painter's task.

The last thing to do is to apply the finishing touches on the stage, with the electric lights turned on mainly to secure accordance with the actors' dresses, putting on a new tone here and there and attenuating or reinforcing the tints wherever necessary to produce the desired effects (Fig. 8). A finished example of the painter's work is shown in Fig. 9 in an exterior view from the third act of "Faust."

The Proposed Trans-Sahara Railway

A RAILROAD project of great scope is the Trans-Sahara line, which the French government proposes to carry out in the near future. Not long ago several expeditions were sent out in order to study the conditions for running the railroad across the desert region, and this part of the work is now terminated. It is thought that the entire plans can be drawn up before the end of this year. Such a railroad will afford a connection between Algeria, Morocco and the desert region, with the French colonies situated in the regions of the Congo and the Niger, so as to inter-connect all the colonies, whence a great advantage will be secured not only for commerce, but also for military purposes, allowing the native troops which it is proposed to raise in the Senegal and Congo region to be transported to the north of Africa or even across the Mediterranean into France under the protection of the fleet. The present expedition consisted of a number of leading engineers and officers of the War Department, and a caravan of 50 men and 120 camels started from El Aoulef, the southern terminus of the Algerian railroad, in order to cross the desert. The expedition divided at Silet in order to explore several different regions. Among others, Dr. Nieger took a southeastern route, so as to find the best conditions for running the railroad as far as Lake Tchad. His party then returned through British Nigeria by way of the new railroad from Kano to the coast. The other expeditions followed different routes in order to trace lines for the general project, and in all cases the proposed lines make connection with already-existing railroads in the southern region lying between Timbuctoo and Lake Tchad.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

"Roundhouse Attention" for Motor Vehicles

By John R. Eustis

THAT more commercial motor vehicles fail to give satisfactory service because they are not operated and cared for properly than because of inferior design and construction is a fact well known to transportation engineers. The modern motor truck and delivery wagon are built to stand hard service, provided they are properly cared for in the garage.

"Roundhouse attention" is the name given to this requirement, and it is taken from railroad parlance. Its significance in this case is that the motor vehicle should have the same careful attention at the end of each day's work that the railroad locomotive receives at the end of each trip. If the locomotive requires inspection and adjustment at the end of a run over smooth steel rails, how much more should a motor truck receive the same after a long day's work over rough roads, in which it is jolted and strained in a way a locomotive is never subjected to. The time required for this is seldom longer than it takes a horse driver to unharness, clean and feed his team at the close of a day's work.

Such attention pays for itself many times over in dollars and cents. There is almost as much opportunity to increase motor truck efficiency in the garage service as there is in providing proper loading and unloading facilities or in routing deliveries. The railroads furnish an illustration of this, in that the total cost per locomotive mile for the four leading lines running out of New York, for the year 1911, varied from 4 to 16.6 cents, and the lowest figure was for the line with the severest grades. This variance of over three hundred per cent must be largely attributed to the difference in maintenance service.

The Horse's Board Bill

ONE factor which is exerting a powerful influence in favor of motor trucks is the steadily increasing cost of using horses, purchase price and maintenance, stable rent, drivers' wages and feed included.

According to Census Bureau figures the valuation of horses in the United States has increased 137 per cent in the last ten years, while the increase in number has been only 13 per cent. The total number at the time of the last census was 24,016,024.

In the same period the value of hay has advanced from $10 per ton to over $20, and corn and oats have increased in value proportionately. Land values have increased in most sections of New York, taxes in all sections, and these are the factors which govern the renting value of stable properties. This same condition holds true in practically every commercial center.

Motor Trucks at the Electrical Show

AT the recent Electrical Exhibition in the New Grand Central Palace, New York, motor trucks were well represented. There were half a dozen different exhibits in which the motor trucks were shown in varying types, from the powerful ones used by breweries to a small baggage truck of two thousand pounds capacity. Mounted upon one of the larger trucks was an automatic bottle capping machine. The machine was driven by power obtained from the battery of the truck. The manufacturers of this truck were anxious to display the model at the Electrical Show, but the only one available was in service of the inventor of the bottle capping machine, who used this method of demonstrating his invention, and so they induced him to let them exhibit the truck, machine and all. The bottle capping machine, which, by the way, was a very ingenious one, served to attract attention to the truck exhibit and also emphasized the fact that the electric truck is very adaptable; for the power stored in its battery may be used to advantage on all manner of machinery mounted on it or in its immediate vicinity.

One of the most interesting features of the show was the indoor track on the third floor, where electric automobile demonstrations were made and driving lessons were given without charge, under the auspices of the New York Electric Vehicle Association. Not only were pleasure vehicles demonstrated, but also small electric trucks. To emphasize the fact that very little power is used by a truck, the following sign was displayed:

"Less current is consumed by a one-ton electric truck, carrying a load one mile, than by the above lamps, burning one hour."

The lamps referred to were three 32 candle-power carbon filament lamps. By a one-ton truck, of course, is meant a truck that carries a load of two thousand pounds. The weight of the truck itself would be in the neighborhood of four thousand pounds. Thus, we have about three tons, altogether, carried by 300 watts or 0.4 horse-power.

Delivery Service of New York's Department Stores

By Morris A. Hall

THERE are said to be 1,405 department stores in the United States, of which New York city possesses not less than 10 per cent, and probably more, Manhattan alone being credited with 90, while a good many of the largest are classified as drygoods stores. These serve not less than 15,000,000 people.

To do this, it has been necessary in the past to maintain enormous stables of horses, with a tremendous proportion of reserve horses in order to take care of all emergencies. With the coming of the motor truck, however, this has been changed materially, and although the total number of horses and wagons is still very large, the greater proportion of these is the property of smaller and less progressive firms. In fact, it may be stated that now four of the largest firms are using no horses whatever, and not less than six will be in a similar condition within two years.

The whole number of motor vehicles now used by the New York department stores is estimated by the writer at 700, with 525 in Manhattan, and 175 in Brooklyn and other boroughs. Of these approximately 290 are electrics, the balance, 410, gasoline. At the same time, about 3,000 horses are still in use hauling 1,900 wagons. Some of these will never be replaced, but approximately half of them will, making a place with the natural growth of the businesses for about 1,000 more trucks in the next five years.

Some idea of the extent of area served and magnitude of the general proposition of large department store delivery may be gained from a description of several of them. R. H. Macy & Co., for instance, covers all places south as far as Lakewood and Point Pleasant, New Jersey, as far west as a straight line north and south through Boonton, Parsippany, Summit, and Fanwood, New Jersey, as far east as Woodbury and Oyster Bay, Long Island, and Stamford, Conn., and as far north as White Plains, Elmsford and Pearl River, New York, and Ramsey, New Jersey.

This makes an area 50 miles wide by 65 miles long, out of which the ocean

cuts a corner approximately 25 by 30 miles. These figures give a resulting land area covered of 2,500 square miles in round figures; that is, half as big as the entire State of Connecticut.

To cover this area in anything like a proper manner requires organization and a well thought out plan. There are nearly twenty depots or sub-stations, the number varying with the character of the service. These are supplied by big 3 and 5-ton gasoline trucks, which make the long runs at night, and in some cases during the day. From the sub-stations radiate the actual deliveries by electric automobile when the distance is long, and by horse when it is short. The majority of retail deliveries in New York city are made from the main store, the Long Island City and Coney Island depots by means of light electrics. These have a radius up to 35 and 40 miles a day, whereas the best the horse can do is 16 to 18, with 22 as a maximum of isolated country delivery.

The entire system includes (the figures vary widely from one month to another): Forty-two motor vehicles, consisting of 7 gasoline trucks and 35 electrics, 200 horses and 150 wagons. For comparison another large store—John Wanamaker—has 75 motor vehicles, consisting of 70 gasoline and 5 electrics, 275 horses and 150 wagons. In the comparison, several points will be noted, primarily the much greater proportion of gasoline cars in the Wanamaker equipment. This shows the individual preference, the Macy Company having always found the electric vehicle very reliable and serviceable, whereas the Wanamaker firm could not be persuaded even to try them until a year ago. Another point is the much larger proportion of horses to wagons in the Wanamaker instance, this firm having 75 more horses for the same number of wagons. It is explained by the fact that horses go out but half a day, those working in the morning being replaced by fresh horses in the afternoon. This scheme enables the serving of a larger territory per wagon, but requires more horses.

Some of the other notable delivery systems of New York city are those of: Gimbel Brothers, which is entirely motor, no horses whatever being used; J. L. Kesner & Co., of which the same is true; Lord & Taylor, Stern Brothers, Greenhut-Siegel Cooper Company, Simpson-Crawford Company, and W. & J. Sloane, not strictly a department store, but having an interesting motor equipment which has gradually displaced all horses. Gimbel's now has 127 motors, 89 electric and 38 gasoline; Kesner's has 45 gasoline vehicles, 42 of the 1-ton size and all of one make; Stern's employs 28 gasoline cars and 2 electrics, as well as many horses; Sloane's has a fleet of 19 cars, of which 4 are electrics; the Greenhut outfit includes 17, all electrics, and many horses; Simpson-Crawford, 16 trucks of which half are electric, and 400 horses for 200 wagons; Lord & Taylor, 13 gasoline cars, 124 horses and 60 wagons; Aitken, Son & Co., 13 electrics and no horses; Arnold, Constable & Co., a fleet of 10 electrics, some gasoline cars and a few horses, and so on down to the smaller houses which have practically all horses, but are trying out a motor truck or two.

Cost figures are more or less difficult to handle, but it may be stated that the Macy electrics (34) averaged 19.15 cents a mile, while the gasoline cars did over 14,000 miles a year at a cost of 17.48 cents a mile. In the Sloane service, a 3-ton truck, doing 42 miles a day for 296 days a year averaged 26.1 cents a mile and 17 cents a ton-mile. Stearns found that the electrics cost about 13 cents a ton-mile, an automobile unit costing $1,780 a year, while the same service from horses came to $3,892 a year, a saving of $1,912 a year for each motor-driven unit. Simpson-Crawford's cost figures show a package cost of 6 cents each by horse and 2½ by automobile. Gimbel's delivery equipment covered 1,500,000 miles last year with an operating cost of 6 cents a ton-mile and a total cost of 50 cents a mile. Greenhut's 1,000-pound cars do 10,500 miles a year at a cost of 5½ cents a mile, or 22 cents a ton-mile; the 1-ton cars, 10,100 miles at 22.46 cents a mile and the same a ton-mile; the 3½-ton electrics, 8,300 miles at a ton-mile total of 10.65 cents.

Generally speaking, the 1-ton truck will do 80 miles a day at a total ton-mile cost of 20 cents, or $8 a day, while a 1-horse wagon will cost $4 a day and do but 22 miles (maximum), making the ton-mile cost 36 cents. Moreover, these figures show that in mileage covered, the former is equal to 3.63, or since a horse cannot be divided, 4 1-horse outfits, which at the $4 a day figure, would amount to $16 a day. Hence, the motor shows a saving of about $12 a day on equal mileage requirements.

However, cost alone is not the deciding factor in the department store's gradual, but very certain adoption of motor trucks, that is its quickness of action, allowing of rapid delivery or as it is usually termed, more prompt service, an extension of available territory and a lowered cost being the secondary deciding factors.

Motor Truck Queries and Answers

F. P. S. writes: On a recent trip abroad I was much impressed by the number of motor omnibusses in service in the large cities, particularly in London and Paris. How many are there in this country, and why are they not generally used here as abroad?

A. The largest and oldest motor omnibus installation in this country is that of the Fifth Avenue Stage Company in New York, which is now operating close to one hundred vehicles. There is a line of four or five running on one of the principal residential thoroughfares of New Haven, Conn., which is nearly as old. A company began operations in Chicago last fall and now owns about a score of vehicles, while another has begun in a small way in Indianapolis. There are a large number of motor stages of various kinds in use throughout this country, and these might be classed as omnibusses. The total number is small, however, compared with the 1,500 motor omnibusses in London and the something more than half this number in Paris.

Among the reasons which undoubtedly explain why motor omnibusses are not generally used here as is the case abroad, is the fact that all types of commercial motor vehicle are of more recent origin in this country than in Europe. Other forms of passenger transportation, particularly the electric street car, have been more highly developed in American cities so that there is not the same need for motor omnibusses. The inferior street surfaces and the difficulty of securing franchises are other contributing factors. Passenger transportation in competition with street cars and interurban trolleys is one of the most promising fields which the future holds for the commercial motor vehicle in this country.

A. J. B. asks: Is motor truck travel unusually hard on stone roads, in comparison with pleasure car and horse traffic? What is the best kind of road surface for motor truck travel?

A. Your questions represent problems as yet unsolved. When motor trucks are over-loaded and over-speeded and unfortunately this is the rule rather than the exception, they are harder on roads than pleasure cars. When road surfaces begin to loosen and show holes, and this condition is largely caused by horse traffic, then motor truck travel becomes destructive, as a heavily loaded, fast moving truck hits each depression with a trip hammer blow. As practically all roads are used by the three kinds of traffic you mention it is difficult if not impossible to ascertain which is the most destructive. Although there are many opinions on the subject, it would seem that a concrete base with a macadam top, the surface of which is bound with a heavy oil of tar, would be the best for motor truck travel.

Lesson of the Railroad Wreck at Westport

(Concluded from page 845.)

like action it lurched over to the right, and was in this position when it entered the second half of the crossover. Here the reaction of the curve on the flanges of the wheels caused the engine to continue heeling over to the right until equilibrium was entirely lost. The wheel flanges (see small sketch) lifted clear of the inner edge of the rail, and the engine shot straight ahead for seventy to eighty feet, landing on its outer right-hand wheels upon the ties on the outside turnout to outer track of the siding. When the writer inspected the scene of the wreck, he found there was not a single scratch on ties or rails throughout the whole crossover.

Now the centrifugal force developed against a curved rail is inversely proportionate to the radius of that curve. The longer the radius, the smaller the centrifugal force. It is perfectly possible (though, of course, more expensive and requiring more careful workmanship) to make a crossover so long and its curvature so easy, that the centrifugal effect, even at sixty miles an hour or more, will not imperil the safety of the train. These facts are well known to railroad engineers, and of late years our best railroads, those which are sincerely desirous to do everything possible to render railroad travel safe, have been taking up the short crossovers laid down in an earlier day and substituting others of a safer type. The New York Central uses, under conditions similar to those at Westport, a No. 18, the radius of whose switch rail is 2,521 feet. The Pennsylvania Railroad Company uses a No. 20, with a radius of 3,442 feet. The Westport No. 10 has a radius of only 942 feet. Consequently, had a New York Central crossover been in place at Westport the centrifugal force would have been not much more than one third as great, and with a Pennsylvania No. 20 in place, it would have been not much over one fourth of that developed by the wrecked train. The New York Central Company has a speed limit, we believe, of forty miles per hour for its No. 18, and the Pennsylvania Railroad imposes no speed limit on its No. 20, the curvature being so easy as to be safe at any speed at which the train can be run.

Furthermore, in showing how well this matter is handled by roads whose officials are sincerely desirous of doing everything, both in the physical construction of the road and in the maintenance of strict discipline, to safeguard its passengers, it should be mentioned that on the shorter crossovers on the Pennsylvania lines on which speed limits are imposed, tests are made at regular intervals of the speed at which engineers run over them. The engineers do not know when such tests will be made, and a violation of the rule meets with instant punishment.

The SCIENTIFIC AMERICAN commends these facts to the serious attention of the general public, and expresses the hope that in the forthcoming legislation which will undoubtedly be the outcome of the Interstate Commerce Commission's investigation of this matter, the constituencies will make it clear to their representatives in Congress that they wish the recommendations of the Commission to be embodied in early and drastic legislation.

Russian Military Flying Machines

THE aeroplanes which will take part in the War Department concourse in Russia are almost entirely of home construction. The entries were closed on August 23d, and it is thought that at least fifteen aeroplanes made by Russian constructors will take part. A series of contests outside the official event will also form part of the programme, and the Russian pilot, Abramovitch, who recently made a flight on his German Wright biplane from Berlin to St. Petersburg, is to take part. It is said that a Holland constructor will make flights with an aeroplane of a new system.